Enhancing self-regulation via prompts and modeling in virtual flipped classroom

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ABSTRACT: This mixed method study aims to address the lack of self-regulation in primary school students through providing self-regulation training with prompts and modeling in virtual flipped classroom (VFC). A four-week training was integrated into an extra-curricular program of Chinese speech with prompts or modeling embedded in pre-class videos. The study examines to what extent and how prompts and modeling affect students' self-regulation and learning outcome. Forty-two primary school students from Grades 4 to 6 were randomly assigned into the prompt group and the modeling group. Both groups had not received self-regulation training before and did not show significant difference in the pre-test of self-regulation and the ability of speaking Chinese. The study collects multiple types of data including questionnaires, students' notes, observations, interviews, and speaking tests. The study is innovative as it directly compares the effectiveness of modeling and prompts on enhancing students' self-regulation. The results show that both prompts and modeling are effective in enhancing students' self-regulation and learning outcome with modeling having an edge over prompts. The students and their parents expressed positive views towards self-regulation training in the program. This study provides several implications for practitioners on how to cultivate students' self-regulation.

Keywords: Self-regulation, Prompts, Modeling, Flipped classroom

1. Introduction

Flipped classroom that combines online and face-to-face teaching becomes an increasingly popular mode of learning in the past decade (Akcayir & Akcayir, 2018). Empirical studies have reported that flipped classroom is more effective than traditional classroom at primary, secondary, and tertiary levels (e.g., Clark, 2015; Lai & Hwang, 2016; Lo & Hew, 2017; Unal & Unal, 2017; Wei et al., 2020; Yang & Chen, 2020). The virtual flipped classroom (VFC) mode is an emerging field that differs from the traditional flipped classroom in the in-class stage: traditional flipped classroom is conducted in-person whereas VFC adopts synchronous online meeting during in-class stage (Ismail & Abdulla, 2019; Jensen et al., 2018). The pre-class stage of the two modes are similar with students learn at home on their own (Akcayir & Akcayir, 2018). When learning takes place outside classroom, it puts higher demand for self-regulation on the part of students (Lai & Hwang, 2016). However, the lack of self-regulation is observed as a common problem when students learn in an online mode (Li & Zhou, 2021). Self-regulation has been generally recognized as vital for academic success and especially so in online learning (Barnard et al., 2009; Broadbent & Poon, 2015; Jansen et al., 2019; Sitzmann et al., 2011; Zimmerman, 2011). As such, there is a strong need to enhance students' self-regulation when implementing flipped classroom.

Direct training has been hailed as an effective measure for developing students' self-regulation and improving learning outcomes in online learning environment (Dignath & Büttner, 2008; Gentry et al., 2020; Theobald, 2021). This study sets out to tackle the lack of self-regulation of primary school students in a VFC mode through providing training of self-regulation. On account that self-regulation is a rather abstract concept for primary students, we embedded prompts and modeling into the educational videos to facilitate the training. Prompts are visual cues used in the self-regulation training to guide students in regulating their learning (Bannert & Reimann, 2012). Modeling involves a person or a virtual character demonstrating the desirable actions and thoughts (Bandura, 2012). Both prompts and modeling have been implemented in the previous studies to facilitate the training of self-regulation, yet no study, to our best knowledge, has compared their effectiveness. In this study, we explicitly embed prompts for self-regulation and the modeling of self-regulation into the pre-class videos in an effort to enhance students' self-reflection and compare the effectiveness of prompts and modeling.

2. Literature review

2.1. Traditional and virtual flipped classroom

In the past decade, traditional flipped classroom has attracted increasing research attention in various disciplines (e.g., Lo & Hew, 2017; Song & Kapur, 2017, Lee & Choi, 2019). Traditional flipped classroom usually involves pre-class and in-class stages. In the pre-class stage, students learn in an asynchronous mode on their own with various learning materials such as readings, videos or a combination of the two (Clark, 2015; Lee & Choi, 2019; Yang & Chen, 2020). Learning videos can be supplemented with quizzes for checking students' progress (Lee & Choi, 2019). The in-class stage is reserved for activities such as group work and individual practice (Bergmann & Sams, 2012; Clark, 2015; Jensen et al., 2015; Lage et al., 2000; Lin et al., 2021) that may contribute to active learning and collaboration among students (Akcayir & Akcayir, 2018; Bergmann & Sams, 2016; Clark, 2015; Hoshang et al., 2021).

VFC, as an integration of virtual classroom and flipped classroom, began to emerge in recent years (e.g., Ismail & Abdulla, 2019; Phillips & O'Flaherty, 2019). Similar to traditional flipped classroom, VFC also involves pre-class and in-class stages with the pre-class stage carried out in an asynchronous mode. Yet the in-class stage of VFC is held in a virtual classroom with the use of video conferencing for real-time communication (Ismail & Abdulla, 2019; Lervik et al., 2016). With the closure of schools during the COVID-19 pandemic, VFC has gained popularity. Studies have shown that teachers could blend a range of synchronous and asynchronous tools to facilitate student learning. For instance, Gopalan et al. (2021) provided students with guided reading and lecture videos as pre-class activities and implemented online assessments and group activities in breakout rooms when the class met online. Li and Zhou (2021) reported a case of VFC with structured components including preview before class, in-class discussion, and the assignment after class. To enhance student engagement, they designed various activities for the in-class stage such as group discussions in breakout rooms, group presentations and feedback. Moreover, the existing research work has reported mixed findings of VFC on learning outcomes. For example, Ismail and Abdulla (2019) reported significant knowledge gain in a quasi-experiment study of implementing VFC while Stöhr et al. (2020) showed no significant difference in learning outcomes between VFC and traditional teaching.

2.2. Self-regulated learning

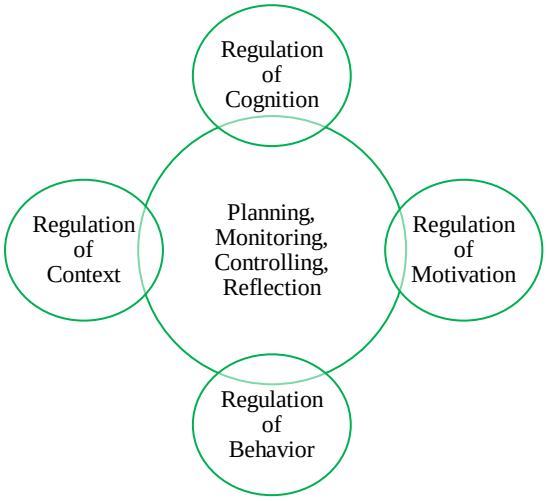
Scholars in the field of self-regulated learning have developed various models on the basis of different theoretical foundations. Irrespective of the different origins, the models of self-regulated learning share some characteristics. First, self-regulated learning is often viewed as a multi-dimensional concept encompassing the dimensions of cognition, motivation, context, and behavior (Pintrich, 2000; Zimmerman, 2013). Second, self-regulated learning has been conceptualized as a process involving different stages moving towards a goal (Pintrich, 2000; Winne & Hadwin, 1998; Zimmerman, 1998). Among different models, Pintrich's (2000) model was selected for the study due to its comprehensiveness in providing clear description of the stages and dimensions for self-regulation as described below.

Pintrich's (2000) model depicts four areas of self-regulation including cognition, behavior, context, and motivation. Each area can be regulated via four phases including planning, monitoring, controlling, and reflection (see Figure 1). Regulation of cognition involves cognitive planning, monitoring, controlling and reflection. Learners set learning goals, recall prior knowledge as well as strategies of self-regulation. They check their understanding, select appropriate learning strategies, and evaluate whether the goals have been met. Regulation of behavior includes behavioral planning, monitoring, controlling, and reflection. Learners plan their time and effort, decide whether or not to persist, adjust the effort spent in learning, and reflect on the decisions made. Regulation of motivation comprises motivational planning, monitoring, controlling, and reflection. Learners think about the value of learning, self-efficacy in learning, and the feelings of achieving goals. They become aware of the level of motivation and select strategies for keeping oneself motivated. Regulation of context comprises of contextual planning, monitoring, controlling, and reflection. Learners become aware of the contextual distraction, select strategies for improving the contexts or tasks, and evaluate the changed context.

Pintrich's (2000) model has been applied widely in the empirical studies concerning self-regulation. In the context of primary school, for example, Meier and Vogt (2015) examined the self-regulation of Grades 4 to 6 students during inquiry learning and reported evidences of cognitive planning, monitoring, controlling, and reflection. In a quantitative study, Kaya and Kablan (2013) denoted that self-regulation of Grade 4 students were

positively linked to the learning achievement. In our study, the four areas and stages of regulation in Pintrich's (2000) model guided the design of the self-regulation training for the students.

Figure 1. Summary of Pintrich's (2000) model



2.3. Training for self-regulated learning

The fundamental premise of this study is that self-regulation can be acquired through training. Training for self-regulated learning benefits students at different levels, from primary, secondary to university students (Dignath & Büttner, 2008; Dignath et al., 2008; Jansen et al., 2019; Theobald, 2021; Zheng, 2016). The current study focuses on two approaches – prompts and modeling since the previous studies have indicated their popularity and effectiveness for enhancing self-regulation (e.g., Moos & Bonde, 2016; Wijnia & Baars, 2021). These two methods are particularly suitable for VFC as they can be embedded in the videos for pre-class learning phase. However, they differ in the modality of presentation: prompts were presented in words and sounds, while modeling segments were presented through visual images and sounds. The comparison of them can shed lights on whether the modality of presentation leads to any differences in learning self-regulation.

2.3.1. Prompts

Self-regulatory prompts are cues specifically used to guide students to regulate their own learning (Bannert & Reimann, 2012). Empirical studies have used self-regulatory prompts in the form of questions, phrases as options, and statements as instructions (e.g., Lai & Hwang, 2016; Moos & Bonde, 2016; Müller & Seufert, 2018). Prompts have been widely used to foster self-regulated learning in traditional and online learning contexts (e.g., Daumiller & Dresel, 2019; Engelmann & Bannert, 2021; Ferreira et al., 2015; Müller & Seufert, 2018; Osborne et al., 2021; Schumacher & Ifenthaler, 2021; Sonnenberg & Bannert, 2019). However, some studies only involved the training of self-regulation in specific aspects. For example, Sonnenberg and Bannert (2019) embedded prompts focusing on cognitive regulation in online learning materials and reported that the group receiving prompts showed a higher frequency of cognitive monitoring of understanding.

There are only a few studies that explored the use of self-regulatory prompts in the flipped classroom mode. In the quasi-experimental study of Lai and Hwang (2016), primary students set goals in pre-class phase and the teacher clarified concepts during in-class phase followed by students' reflection on their learning after class. Their study shows that primary students receiving prompts on the regulation of cognition and time management had higher awareness of setting targets, using strategies and time planning. It indicated that the prompts were effective in raising the awareness of cognitive planning, cognitive controlling, and behavioural planning in Pintrich's (2000) model. Similarly, in the study of Moos and Bonde (2016), university students who received the prompts for cognitive regulation performed better in recalling prior knowledge, being aware of their understanding, and controlling their behaviours.

2.3.2. Modeling

Modeling is another useful means of enhancing self-regulated learning (Pintrich, 2000; Schunk, 1995; Kitsantas et al., 2000). Studies have shown that the positive effects of modeling self-regulatory strategies on students' regulation (Raaijmakers et al., 2018; Wijnia & Baars, 2021, Cleary & Zimmerman, 2004). Similar to the studies involving prompts, the studies using modeling also tend to focus on cognitive regulation. For instance, Raaijmakers et al. (2018) used video-based modeling for the demonstration of mathematical problem solving and reported that students successfully applied such skills in solving problems. When it comes to the context of flipped classroom, the studies of self-regulation training via modeling are even more scarce than those of prompts. In one of such studies, Wijnia and Baars (2021) provided video-based modeling of cognitive regulation for Dutch secondary students and showed that the students could apply the skills in solving biological problems.

2.4. Research gaps

On the whole, the existing work in relation to VFC is mostly contextualized in higher education with a dearth of empirical studies in primary school context. Additionally, the empirical studies on the implementation of VFC showed mixed findings. For example, Ismail and Abdulla (2019) reported significant difference in student learning in the VFC. However, Phillips and O'Flaherty (2019) compared one group learning through VFC with the other group in blended learning mode and noted little difference in learning between the two. Such mixed findings lead to the necessity of further exploring student learning in VFC. Second, the study that involved the training of self-regulation often concerned the regulation of cognition, motivation, behavior whereas the regulation of context is often neglected (Hensley et al., 2022). Third, considering that pedagogical design is crucial for the implementation of flipped classroom (Song et al., 2017), more research on pedagogical design of supporting self-regulation is necessary for successful implementation of flipped classroom. More importantly, there has not yet been studies comparing prompts and modeling in enhancing self-regulation in VFC.

3. Methods

3.1. The present study and research questions

The current study aims to foster self-regulation of primary students via prompts and modeling in virtual flipped-classroom. Pintrich's (2000) model of self-regulation is adopted as the theoretical framework to guide the design of the training and data analysis. Three research questions are posed to guide our study:

- To what extent and how do prompts and modeling affect primary students' regulation of cognition, behaviour, context, and motivation in VFC?
- Is there any difference in learning outcome of primary students receiving self-regulation training via prompts and modeling?
- What are the perceptions of students, their parents and the teacher on learning self-regulation using prompts and modeling in VFC?

3.2. Research design

Contextualized in a private primary school in Hong Kong, this study adopted an experimental mixed method research design. A four-week training on self-regulation was integrated into an extra-curricular program for the Chinese Speech Club by embedding prompts or modeling in learning videos for the pre-class phase. That is to say, the videos prepared for the pre-class stage included both lectures on learning content (Chinese speech) and self-regulation training. We recruited forty-two students from each level of upper primary section (P4, P5, P6) who joined the speech club. The participating students included 22 female and 20 male students between nine to eleven years old. The students were randomly assigned to two groups: the prompt group (FCP) and the modeling group (FCM). Each group had a similar composition of students with no prior training of self-regulation. The learning contents and structure of the training were the same for the two groups and both groups were taught by the same teacher who had 14 years' experience of teaching Chinese.

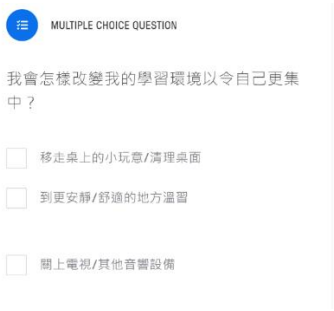
The self-regulation training included the same content which was designed as prompts and modeling videos for the two groups respectively. That is to say, the main difference between the prompts group and modeling group was the mode of presentation of self-regulation training: prompts of self-regulation were provided in text format whereas modeling videos involved the teacher demonstrating the self-regulation strategies (see Figure 2). Sixteen

videos (about ten minutes for each) were prepared, eight for each group. As shown in Table 1, the four aspects of self-regulation were introduced progressively in the training.

The content of each FCP video included prompts (including questions and options) designed based on Pintrich's (2000) model and the instructional videos on delivering speech. The videos were then uploaded to Edpuzzle and prompts were inserted at different places of the videos. The production of FCM videos was more complicated as additional modelling video was developed with the teacher modeling self-regulation while watching the sample lesson. The preparation work included scenario brainstorming, scene setting and prop preparation. The scenario and the scene were developed based on Pintrich's (2000) model and the strategies demonstrated echoed with the prompts provided for FCP group. The finished video for FCM group was also uploaded to the platform of Edpuzzle.

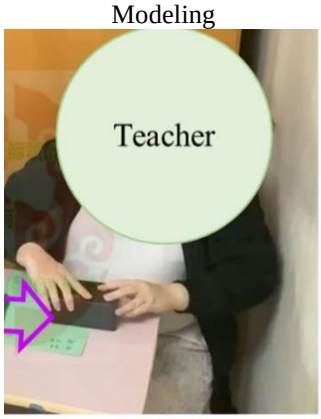
Figure 2. An example of prompts and modeling of regulating context

Prompts



Translation:
How can I change my learning environment to make myself to be more attentive?
□ Remove toys / Tidy the desk
□ Go to a quiet / comfortable place to study
□Switch off the television / other audio equipment

Modeling



Description:
The teacher stopped playing with the toys on the desk. She opened the box, put the toys into it and then covered it.

Table 1. Progression of integrating self-regulation

	New aspect added
Lesson 1 and Lesson 2	Regulation of cognition
Lesson 3 and Lesson 4	Regulation of behavior
Lesson 5	Regulation of context
Lesson 6	Regulation of motivation
Lesson 7-8	(All aspects included)

3.3. Instruments and data collection

In the current study, mixed methods were used to collect various data including questionnaires, speaking tests, lesson observation, interviews, and students' notes (see Table 2). The effects of self-regulation training on students' learning and self-regulation were measured through pre- and post-questionnaires before and after the four-week program. We adapted the shortened version of Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich & DeGroot, 1990) to measure the level of self-regulation. Behavior and study environment regulation from the original version were added to the shortened version. Apart from individual aspects, the self-regulation scale measured self-regulation as a whole. The reliability tests of the self-regulation scale including use of cognitive strategies (regulation of cognition), behaviour (regulation of behaviour), study environment (regulation of context), intrinsic value and self-efficacy (regulating motivation), and overall self-regulation yielded the results from 0.708 to 0.827. Additionally, the questions were added to the questionnaire to collect students' opinions. An example of the questionnaire items is "I have a regular place set aside for studying". Speaking tests were conducted at the beginning and upon the completion of the program to measure students' learning outcome. In the pre- and post-speaking tests, students were required to give a two-minute speech with the script provided. They were assessed based on the content covered in the course including the application of stress and pausing for delivering a clear message and non-verbal communication like eye contact, facial expression, hand gestures and posture. Each item was rated based on a four-point grade level. The values of Cronbach's alphas for delivering a clear message and non-verbal communication were 0.971 and 0.830.

Table 2. Summary of data collection

Measurement	Self-regulated learning	Speaking	Perception
Notes	✓		
Speaking test		✓	
Questionnaire	✓		✓
Lesson observation	✓		
Interview	✓		✓

During the synchronous class through Zoom, the students were expected to apply the self-regulation strategies acquired in the training. All the synchronous online classes were observed via Zoom in order to examine whether the students could apply the self-regulation strategies. One teacher with 12 years of teaching experience joined the researcher in the observation. The observation form was compiled with a list of possible indicators of regulation grouped into four areas of Pintrich's (2000) model. For example, the indicators for the regulation of context included wearing earphones, asking siblings to go away. The form was completed at a five-minute interval during the observation. The inter-rater agreement for Lesson 1 and Lesson 8 is 81% and 85%. The average frequency of each item was calculated for comparison. In addition, the students voluntarily took notes during the course without unified format and took photos of their notes for submission.

Interviews were conducted with all the students, their parents and the teacher after the program. Individual semi-structured interviews were conducted with 42 students and their parents to have a better understanding of their perceptions of the training. Some sample questions are: "What do you think about learning self-regulated learning in flipped classroom used in this course? Why?", "What do you think about using modeling (for FCM group) / prompts (for FCP group) in videos to learn self-regulated learning? Why?", and "In videos, the teacher took on the role of a child to learn. What do you think about it? Why?" (for FCM group). To elicit the students' opinions, three questionnaire items were added at the end of the post-questionnaire including (1) "I am satisfied with the speaking course"; (2) "I like the mode of learning in the course (online flipped classroom)"; (3) "I think demonstration in videos can help me learn self-regulated learning" for the FCM group and "I think prompts in videos can help me learn self-regulated learning" for the FCP group.

3.4. Data analysis

When analyzing quantitative data, Quade's test and Wilcoxon signed rank test were conducted due to two reasons. First, the data were not normally distributed, making non-parametric tests suitable. Second, as this study aims to examine individual aspects of self-regulation including regulation of cognition, motivation, context, and behaviour, univariate analysis is suitable for studying various aspects separately (Huberty & Morris, 1989). For the qualitative data, top-down and bottom-up approaches were used for thematic analysis of interviews and content analysis of the students' notes. Pintrich's (2000) model provided the basis for data analysis which helped the integration and comparison of data collected via different means. With the bottom-up approach, new insights and themes emerged from the data could supplement the model. In other words, most codes were derived from Pintrich's (2000) model with codes emerged from data added in through iterative thematic analysis. Table 3 shows the coding list for the regulation of cognition.

For observation data, the average frequency of each item was calculated for comparison in an effort to detect the pattern of students' self-regulation behavior. One tenth of the notes were analysed twice within a week with a percentage agreement of 92%. Additionally, two other experienced teachers were involved in data collection and evaluation which enhanced the reliability and validity of the data.

Table 3. Coding list for regulation of cognition

Codes	Indicators	Example
Subcategory: Cognitive planning		
Setting goals for learning Chinese	Students write the Chinese topic they expect to learn.	(a) I expect to learn stress and pausing. (b) Stress and Pausing
Setting goals for learning SRL	Students write the aspects of self-regulated learning they expect to learn.	(a) I expect to learn self-regulated learning (cognition). (b) Self-Regulated Learning – Cognition
Activating prior knowledge	Students write what they know about Chinese speech.	Prior knowledge: -Eye contact -hand gestures

Activating prior SRL knowledge	Students write what they know about SRL.	Skills learnt: (timeline)
Subcategory: Cognitive monitoring		
Monitoring cognition	Students clearly show that they understand the content either by adding ticks or expressing in words.	(a) Pronunciation – Read every word clearly. ✓ (b) Understand
Subcategory: Cognitive controlling		
Listing	Students list all the key words one after another.	Common hand gestures for public speaking - A palm - Both palms - Fingers - A fist
Dividing knowledge into different levels	Students highlight, underline, or add a symbol to important information.	(a) Meeting at work (b) Functions of Hand Gestures (c) * Expository Speech
Summarizing lecture by rephrasing	Students express what's learned in their own words.	(a) To sum up, don't use hand gestures in a strange way. (b) Quiet (soft but audible)
Self-questioning on Chinese content	Students question themselves on Chinese content. They either write personal questions, write impersonal questions or write new examples which implies questioning themselves to provide more examples.	(a) What other body language should I use? (b) What is delivering a speech? (c) "gwong" "gong"
Organizing ideas using graphic organizers	Students integrate key words together by using graphic organizers like tree diagrams, mind maps and tables.	A mind map.
Using pictures	Students draw pictures to supplement the words written.	Students drew a head with arrows to show direction of turning head.
Subcategory: Cognitive reflection		
Reflecting on cognition	Students reflect on what they learnt at the end and write their reflection in sentences or phases.	(a) I have learnt: The use of stress in giving a speech (b) Summary: Learnt ways of relieving myself to lower nervousness (c) Eye contact and facial expression

4. Results

This study focuses on exploring and comparing the effectiveness of prompts and modeling on primary school students' self-regulation and learning outcome. The results are based on questionnaires, students' notes, lesson observation, interviews and speaking tests.

4.1. Effects of prompts and modeling on self-regulation and learning

First, we examined and compared the effects of self-regulatory training involving modeling and prompts on students' self-regulation by comparing the pre- and post-questionnaire data. As to overall self-regulation, the results of Wilcoxon signed rank test show a significant rise in the prompt group (Z = -4.019, p < .001) as well as the modeling group (Z = -4.020, p < .001). By controlling pre-test score, Quade's test results show a significant difference between the two groups (F(1, 40) = 20.335, p < .001) with a large effect size (*partial eta square* = 0.337) indicating a larger increase in FCM group (*Mdn* = 6.13) than FCP group (*Mdn* = 5.50).

A similar pattern was observed when we looked into the four areas of self-regulation including cognition, behavior, context, and motivation. With regard to cognitive regulation, Wilcoxon signed rank test indicates a significant rise in FCP group (Z = -3.923, p < .001) and FCM group (Z = -4.017, p < .001). Quade's test shows a significant difference between the two groups (F(1, 40) = 17.862, p < .001), with a larger increase in FCM group (*Mdn* = 6.00) than FCP group (*Mdn* = 5.250). As to behavioral regulation, a significant rise is noted for FCP group (Z = -3.930, p < .001) as well as FCM group (Z = -4.020, p < .001) upon conducting Wilcoxon signed

rank test. Quade's test also indicates a significant difference between the two groups ($F(1,40) = 6.421$, $p < .05$), with FCM group ($Mdn = 5.75$) showing a higher increase than FCP group ($Mdn = 5.50$).

In terms of regulation of motivation, we measured intrinsic value and self-efficacy as the sub-items and noted the improvement in both for two groups of students. A significant rise is noted in intrinsic value for FCP group ($Z = -2.511$, $p < .05$) as well as FCM group ($Z = -3.140$, $p < .01$). Yet, there is no significant difference between the two groups ($F(1, 40) = 0.020$, $p > 0.5$). As to self-efficacy, the similar increment is observed for FCP group ($Z = -2.908$, $p < .01$) as well as FCM group ($Z = -4.017$, $p < .001$). A significant difference is also noted between the two ($F(1, 40) = 14.042$, $p < .01$) with FCM group ($Mdn = 5.00$) showing larger improvement than FCP group ($Mdn = 4.86$). As to the regulation of context, the results from Wilcoxon signed rank test shows a significant increase in FCP group ($Z = -3.528$, $p < .001$) as well as FCM group ($Z = -3.930$, $p < .001$) with a large effect size ($r = -0.544$). Again, Quade's test shows a significant difference ($F(1, 40) = 17.185$, $p < .001$) between FCP group ($Mdn = 5.667$) and FCM group ($Mdn = 6.333$), which indicates that FCM group outperformed FCP group in the regulation of context. To summarize, both prompts and modeling are effective in enhancing the overall and individual aspects of self-regulation. Modeling is more effective in enhancing self-regulation as compared to prompts in overall self-regulation and regulation of cognition, behavior, context and motivation measured in term of self-efficacy.

We also examined the effects of treatments on learning outcome through the pre- and post-speaking tests before and after the program. A significant rise was noted in the prompt group ($Z = -4.019$, $p < .001$) and the modeling group ($Z = -4.019$, $p < .001$). In addition, Quade's test was conducted to find the variation between the two groups. Having controlled the pre-test score, a significant variation was noted between prompts ($Mdn = 85$) and modeling ($Mdn = 93.00$) groups ($F(1, 40) = 10.042$, $p < .01$). In short, the modeling group outperformed the prompt group in both self-regulation and learning outcome.

4.2. Process of self-regulation

Other than the effects of self-regulation training, we also scrutinized how students regulated their learning in virtual classroom with the help of prompts or modeling videos. The rich data from interviews, students' notes, and observation provide a detailed account of the regulation of cognitive, behavior, context, and motivation.

4.2.1. Regulation of cognition

We collected and analyzed 179 sets of notes from the pre-class stage and 78 sets from in-class stage. First, more students from FCM group took notes during pre-class (70 from FCP and 109 from FCM) and in-class stages (28 from FCP and 50 from FCM). The content analysis of notes revealed the signs of cognitive regulation in all the aspects including cognitive planning, monitoring, controlling, and reflection with cognitive controlling as the most frequent and cognitive monitoring as the least frequent aspect. For cognitive monitoring and reflection, there is a higher frequency in FCM group than FCP group.

Table 4. Cognitive planning in pre-class and in-class notes

Cognitive planning	Frequency (%)			
	Pre-class Notes (Total = 179)		In-class Notes (Total = 78)	
	FCP group	FCM group	FCP group	FCM group
Setting goals for learning Chinese	24%	64%	32%	36%
Setting goals for learning SRL	31%	67%	0%	0%
Activating prior Chinese knowledge	11%	49%	0%	0%
Activating prior SRL knowledge	11%	39%	0%	0%

Table 4 shows the frequency of different strategies of cognitive planning shown in students' notes. During the pre-class stage, the frequency of all items (setting goals for learning Chinese speech, setting goals for learning SRL, activating prior knowledge, and activating prior SRL knowledge) is higher in FCM group than FCP group. For the in-class stage, FCM group also showed a higher frequency of goal setting for learning Chinese speech than FCP group. These suggest that both groups were able to apply goal setting and FCM group was more successful in learning and applying cognitive planning. Both groups showed no sign of setting goals and activating prior knowledge for self-regulated learning for in-class sessions. Possible reasons might be that students learnt self-regulation in pre-class videos only and did not expect to learn new self-regulation skills

during in-class sessions. There were no signs for activating prior knowledge of delivering speech as the students might have thought that they had activated such knowledge in pre-class sessions.

Table 5. Cognitive controlling in pre-class and in-class notes

Cognitive control	Frequency (%)			
	Pre-class Notes (Total = 179)		In-class Notes (Total = 78)	
	FCP group	FCM group	FCP group	FCM group
Listing	77%	72%	64%	54%
Dividing knowledge into different levels	0%	34%	11%	14%
Summarizing lectures by rephrasing	13%	57%	25%	52%
Asking questions	21%	35%	21%	26%
Organizing ideas using graphic organizers	21%	35%	29%	48%

Table 5 shows the frequency of cognitive control (e.g., listing key ideas, summarizing, organizing ideas using graphic organizers) noted in pre-class and in-class notes. Most often, the students took notes of the key points and both groups showed a similar level of frequency. However, FCM group shows a higher frequency of more advanced skills (e.g., highlight, summarizing, self-questioning, and creating graphic organizers) than FCP group. A possible reason might be that FCM group were more confident in applying more advanced skills after watching modeling videos.

During the individual interviews, the students also acknowledged cognitive controlling as the most useful strategies. The students believed that taking notes helped them remember what they learnt more easily. Additionally, they could review their notes to gain a deeper understanding as Student 40 commented: "After taking notes, I read it several times. Hence, I had a clearer understanding."

4.2.2. Regulation of behavior

The individual interviews with the students provided rich and detailed description of how they use behavioral regulation including behavioral planning, monitoring, and controlling. First, behavioral controlling was the most useful strategies and many students believed that timetable was important as they could see clearly what they needed to do. For example, Student 32 commented: "It (timetable) made me know what I could do. So I will not … get confused and distracted." Additionally, they believed that planning and monitoring time was crucial for the effective use of time. Furthermore, the students regarded maintaining persistence, mainly through self-talk, as one of the most useful strategies that they frequently used. Student 3 described such instance as "I told myself to persist for five more minutes." In consistent with the questionnaire data, the content analysis of notes taken in pre-class and in-class phases shows the signs of regulation of behavior like creating timetable and ticking completed tasks. The occurrence of behavioral planning and behavioral monitoring is higher in FCM notes than FCP notes.

4.2.3. Regulation of context

The interview data provided more detailed account of how students regulated their learning context. Among the strategies for regulating context, contextual monitoring and contextual controlling were the most useful ones that they frequently implemented. For example, Student 9 reported: "When I was in a noisy context, I could not hear my teacher. I missed some notes and could not focus." Student 12 also mentioned: "I went to a place without so much noise." Furthermore, the observation data showed the enhancement in regulating context for both groups during in-class learning. There is a decreasing trend in the frequency of looking around, talking to family members, playing with things, having background noise and family members walking by. Consistent with the questionnaire data, the decrease is more salient in FCM group which may imply the better regulation of context on the part of FCM group.

4.2.4. Regulation of motivation

The individual interviews with the students provide more concrete description of most useful strategies for regulating motivation like rewards and self-talk. An example of rewards for extrinsic motivation is mentioned by Student 38: "After the Zoom lesson, I could have a candy. As I wanted to eat a candy, I kept focused." Student 20 provided an example of self-talk for intrinsic motivation: "I told myself, 'After watching the video, I can learn

a lot.' " Student 10 gave another example of using self-talk as a means of motivating oneself to maintain persistence: "I would say something encouraging like 'Add oil (a Hong Kong English expression for encouragement)!' I must not give up!" Furthermore, the content analysis of notes showed the evidence of motivational control through rewarding stickers which was more frequent in FCM group than FCP group.

4.3. Perceptions

We also looked into the perceptions of students, parents and the teacher regarding the self-regulatory training. Concerning the perceptions of students, the questionnaire results showed that both FCP and FCM groups were satisfied with their learning in VFC. Although FCM group (*Mdn* = 7.00) rated higher than FCP group (*Mdn* = 6.00) in course satisfaction and the usefulness of intervention, no significant difference was noted between the groups in course satisfaction, preference of VFC, and the usefulness of prompts or modeling. Aligning with the results of the questionnaire, students expressed positive opinions on the two methods in interviews. Student 23 denoted the function of prompts as such: "The questions reminded me to apply self-regulation." Student 31 expressed the advantage of modelling as such: "The teacher took on our role. It made me understand more easily."

The parents also showed support to the use of prompts and modeling in VFC. Parent 41 mentioned the importance of prompts as such: "Questions for regulation in the middle can lead students to the path that the teacher wants them to take." Parent 32 described the advantage of roleplaying in modeling using a metaphor: "Actually, the teacher's roleplaying is like a mirror… If the teacher does not use the students' angle, … the student may not be able to feel the same." Similarly, Parent 21 mentioned her positive viewpoint on teacher-in-role: "The teacher acted it out, which is really good. The teacher is a special actor; they really can remember and follow her."

The teacher in charge also expressed positive viewpoints on the two methods in use. In particularly, she noted the values of the prompts as such: "The options gave them the ideas of what they could do at different stages." She also expressed the advantages of teacher's roleplaying in modeling: "Children usually think that teachers are experts in particular areas. I think this makes them be willing to follow me to try self-regulated learning. If their schoolmates acted it out, this might not be so persuasive to them."

5. Discussion

In this study, we aimed to improve primary students' self-regulation ability through implementing the training of self-regulation in virtual flipped-classroom context through integrating prompts and modeling into the instructional videos for the pre-class stage. The results indicate that both prompts and modeling can enhance students' self-regulation with modeling outperforming prompts in both pre-class and in-class stages.

5.1. Effectiveness of prompts in enhancing self-regulation

The prompts embedded in the videos served as an effective reminder for students in regulating cognition, behavior, motivation, and context during online learning. Our findings support the previous studies showing the positive effects of prompts on regulating cognition (Ferreira, et al., 2015; Lai & Hwang, 2016; Sonnenberg & Bannert, 2019) and behavior in term of time planning (Fung et al., 2019; Lai & Hwang, 2016; Wong et al., 2021). Meanwhile, we also found the positive effects of prompts on regulating behavior which differs from the study of Moos and Bonde (2016) that reported no signs of monitoring time. The possible reason for the variation in findings might be that the prompts provided by Moos and Bonde (2016) did not target for regulating behavior while our study targeted all four aspects of self-regulation. This suggests that the prompts for regulating different aspects are needed for successful regulation of varied aspects. Apart from the regulation of cognition and behavior, our study provides solid evidence on the effects of prompts on enhancing regulation of motivation and context, filling the gaps in the existing studies regarding the regulation of context (Hensley et al., 2022).

Our findings also provide insights on how prompts help students regulate their learning. First, prompts as questions could remind students to self-regulate, which adds support to the use of prompts for activating strategies (Bannert & Reimann, 2012). Second, suggestions for regulation were included in the prompts in the form of options. This supports the function of prompts in providing directive functions (Wong et al., 2021). The

students of this study expressed that there were times that they did not know how to regulate and the options provided them with the guidance.

5.2. Modeling as a more effective means for enhancing self-regulation

More importantly, the study compares prompts and modeling in their effectiveness in enhancing self-regulation of primary school students. The most note-worthy finding is that modeling is more effective than prompts. There are several reasons that can explain why video-based modeling worked better. First, unlike prompts that are in the forms of written and spoken texts, modeling videos provide richer modality including images and sounds for vivid demonstration. As such, the students could visualize and rehearse self-regulation before the actual application (Bandura, 1986). The actions of observing and emulating the models lead to better internalisation (Schunk & Zimmerman, 2007), which then contributes to better self-regulation.

Second, the demonstration by modeling made the abstract concept of self-regulation more explicit as the students were able to observe the modeled actions and hear verbalized thoughts. Enhanced explicitness facilitated the encoding of new information about self-regulated learning, thereby contributing to the understanding and self-efficacy in relation to self-regulation. All these resulted in an increased willingness to apply self-regulatory strategies since self-regulatory efficacy is related to the willingness to regulate oneself (Bandura, 1986).

Third, the use of teacher role-playing a student in the modeling video also fostered the acceptance of targeted strategies. Such a design was well received by the students as well as parents who thought that it helped develop a sense of kinship. This can be explained by model-observer similarity hypothesis that maintains that the more similar learners perceived the model to be, the more likely they would be influenced and follow suit (Bandura, 1994). All these factors help to explain why modeling is more effective in cultivating self-regulation of students.

5.3. Effects of prompts and modeling on enhancing learning outcome

This study also examined how the training of self-regulation with prompts and modeling affect the learning performance of primary school students in a Chinese speech club. To this end, we measured students' abilities of giving a Chinese speech before and after the program and the students in both prompts and modeling groups showed significant improvement. The positive effect of prompts on learning outcome supports prior studies in online learning and flipped classroom (e.g., Daumiller & Dresel, 2019; Lai & Hwang, 2016; Moos & Bonde, 2016; Müller & Seufert, 2018; Schnauber & Bodemer, 2017; Sonnerberg & Bannert, 2019). Meanwhile, modeling also has the positive effect on learning outcome which aligns with prior studies (Gierlach & Washburn, 2018; Raaijmakers et al., 2018; Rodríguez-Málaga et al, 2021; Wijnia & Baars, 2021).

More importantly, modeling group showed greater improvement than prompts group in their ability of giving a Chinese speech. This might be related to the fact that modeling enhances self-regulation to a greater extent when compared with the prompt group. As self-regulation is positively linked to academic achievement (Zimmerman & Schunk, 2011), it is not surprising that the students in the modeling group also show greater improvement in the learning outcome.

Second, our study in contextualized in VFC mode. An issue of transfer is involved as the self-regulatory training was delivered through videos during the pre-class stage, and we examined students' self-regulatory behavior in both pre-class and in-class stages. To the best of our knowledge, there has not been research examining the transfer of self-regulation in different modes of online learning. Our data indicates that self-regulation can be transferred in two phases within VFC. The students gradually regulated their cognition, behavior, context and motivation not only in asynchronous online learning, but also in synchronous online learning.

6. Conclusion

This study is innovative as it directly compares the effectiveness of modeling and prompts and points out the comparative advantage of modeling in fostering self-regulation as well as students' learning. The results show that both prompts and modeling could enhance the regulation of cognition, behavior, context and motivation and the self-regulated strategies can be transferred from the pre-class to in-class stage of VFC. The students, their parents and the teacher showed positive opinions towards the training of self-regulation in VFC. Notwithstanding the contributions, the study has several limitations. First, it focuses on solving the problem of students' learning

in an extra-curricular program. Caution should be exercised when generalizing the findings to other learning contexts as students might react to the self-regulation training differently when in a regular class. Additionally, the intervention was implemented in the primary level only. It is plausible that prompts and modelling might have different effects on older students such as those in secondary school or university.

The findings of our study give rise to several implications for researchers and educators. There are several directions for future research such as the implementation of similar training to formal regular classes, in secondary or tertiary levels. More importantly, our findings generate several recommendations for educators on how to develop students' self-regulation. First, modeling is recommended and educators can also role-play a student so as to develop a sense of similarity and closeness. The self-regulatory training can be combined with asynchronous online learning tasks as students need self-regulation to tackle these tasks. Yet, teachers need to reserve sufficient time for producing the modelling video. When time is a concern, they can add prompts in the instructional videos. Prompts can be in the forms of multiple-choice questions that remind students to self-regulate. As the online learning is becoming a new normal in schools at all levels, we expect that self-regulation will become increasingly important. The self-regulation in different modes of online and blended learning will be a rich terrain for further exploration.

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