



Effects of interleaved practice with cumulative schedule on Thai lower secondary students' long-term retention of grammatical knowledge and their perception towards the instruction

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Abstract

This study investigated the effects of interleaved practice with a cumulative schedule on Thai lower secondary students' long-term retention of English grammatical knowledge regarding the usage of Past Simple and Present Perfect tense and their perception towards the instruction over fourteen periods in nine weeks. Twenty-three students took a pre-test, immediate post-tests, and a one-week delayed post-test, and twelve of them were also interviewed at the end of the implementation. The qualitative data from the test scores were used to investigate the improvement in grammatical knowledge, as well as the long-term retention, and the data from the semi-structured interviews were analyzed to assess the perceptions towards the overall instruction. The results showed significant improvement in grammatical knowledge in all areas of form, meaning, and use and also elicited statistically significant long-term retention with the increased scores in both the immediate post-test and delayed post-test. For students' perception, the results disclosed that interleaved practice seemed to be harder and more exhausting at first, but after getting familiar with it, the lessons were preferable to blocked lessons. The study recommended interleaved practice tended to be an effective method for improving students' grammatical knowledge and enhancing long-term retention, and it should be applied in the language classroom with well-designed lessons.

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Introduction

One of the most critical issues in learning new knowledge or skills is that students seem to grasp the

concept of the new lesson for only a very short period of time and cannot retain it (Hughes & Lee, 2019). Many researchers agree that the traditional way of teaching, also called blocked practice, is only effective for short-term retention (Gerber & Toppino, 2015; Hughes & Lee, 2019; Nakata & Suzuki, 2019). Moreover, studies have shown, with blocked practice, new knowledge and skills usually fade away quickly once the sessions end (Gerber

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& Toppino, 2015; Hughes & Lee, 2019; Nakata & Suzuki, 2019). Gerbier and Toppino's (2015) study using functional magnetic resonance imaging (fMRI) revealed that, for students receiving blocked practice, their energy through the brain decreased quickly even during the lesson. This phenomenon happens when repeated practices or problems with the same type of solution are presented consecutively, without being interfered by other types of problems or new skills. Neuroscientists call this phenomenon neural suppression or bored brain.

At present, a new practice in scheduling lessons, called interleaved practice, has been proposed. It is the opposite treatment of the traditional lessons, mixing up accumulated knowledge or skills over a long period of time consecutively (Hughes & Lee, 2019; Nakata & Suzuki, 2019; Pan, Tajran, Lovelett, Osuna, & Rickard, 2019). In the language classroom, interleaved practice consists of a lesson in which learners practice different language concepts in an intermixed schedule. It aims to enhance students' accuracy and long-term retention (Kang, 2017; Nakata & Suzuki, 2019; Pan et al., 2019). Interleaved practice seems to be more exhausting and harder from students' perspective, but it does produce better accuracy in long-term results (Pan et al., 2019).

Coding and decoding the message successfully requires grammar (Halliday & Webster, 2002; Kroeger, 2013). The function of grammar is to free language from the constraints of bi-uniqueness — one certain sound or symbol representing one meaning — so that a set of finite expression units (sounds) can create an infinite number of contents (meanings) (Halliday & Matthiessen, 2014). Even though many scholars (e.g., Krashen & Terrell, 1983) believe language learners should be able to pick up accurate linguistic forms incidentally or unconsciously when they are exposed to the target input, there are a number of scholars (Ellis, 2016; Larsen-Freeman, 2001; Spada & Lightbown, 2008) who contend otherwise. They argue that, in the reality of a second language (L2) classroom, very few learners are able to pick up linguistic forms effectively without the help of explicit instruction, especially when the target language is a foreign language most of which merely occurs during class time. A number of studies have supported the idea that providing form-focused instruction (FFI) in a meaningful context is beneficial to L2 acquisition as FFI would raise learners' awareness and turn language input to intake — the information that learners register in their mind (Ellis, 2016; VanPatten, 2017). For instance, VanPatten (2013) concluded that, with explicit FFI, more effective language acquisition would happen as the learners can convert the input to intake, which helps incorporate the target form of

the target language during the processing stage to form their output effectively.

In these recent years, even though there have been some studies on providing interleaved practice in L2 classroom, studies on the effects of applying interleaved FFI lessons in the L2 classroom with young learners are still scarce. In response to the need for more diachronic evidence, the present study was designed for young Thai EFL learners at lower secondary levels to examine the effectiveness of interleaved FFI lessons on better long-term retention of English grammatical knowledge regarding the form, meaning, and use of Past Simple and Present Perfect tense. Additionally, students' perceptions towards the instruction were also investigated.

Literature Review

Interleaved practice refers to a method in which many skills or concepts are taught intermittently in a well-designed organization over a particular period of time (Kang, 2017; Nakata & Suzuki, 2019; Rohrer, Dedrick, & Stershic, 2015). Interleaved practice and blocked practice are contrasted, in that, in blocked practice, one concept or skill is practiced or repeated consecutively (e.g. for hours, days, weeks, or months). Although there has not been much research on interleaved lessons in the language classroom, the idea of interleaved practice is not new. It has been proven to provide a positive impact on skill development, such as mathematics (Taylor & Rohrer, 2010), as well as sports training, and music (Goode & Magill, 2013; Shea & Morgan, 1979).

In recent years, the effects of interleaved practice have been investigated with respect to various language learning areas, as scholars and educators would like to know whether interleaved practice would yield the same benefits to language learners as in other areas. Pan et al. (2019) studied the effects of interleaved practice in learning about conjugating Spanish verbs. The results showed the interleaved group performed substantially better on a 1-week delayed test than the control group. Suzuki and Sunada (2020) studied the effects of interleaved practice on English relative pronouns and relative-clause structures by dividing participants into three groups — blocked, interleaved, and hybrid practice. The result showed that the hybrid practice group gained higher accurate performance scores on the immediate post-test than the blocked and the interleaved, even though, in their study, there was no statistical significance on the one-week delayed post-test.

Interleaved lessons in a cumulative schedule are defined by Hughes and Lee (2019) who state, “When using interleaved practice, related skills should have already been selected, taught to initial mastery, practiced once (or more) in a massed format, and followed by cumulative practice; it is impossible to interleave if the practice is not cumulative... (p.419).” Although many studies have confirmed the effectiveness of interleaved practice, blocked practice is not without its advantages. Blocked practice has been proven to aid in identifying the commonalities within a category and brings about the automatization of the skills being practiced (Suzuki & Sunada, 2020). Therefore, the advantages of both types of practice can be exploited with a cumulative schedule — combining both blocked and interleaved. For example, L2 English learners can first practice Topic A and Topic B in blocked schedule, and when they have enough familiarity and confidence, the interleaved practice can be introduced.

With regard to studies of interleaved lessons in a cumulative schedule, the studies of Nakata and Suzuki (2019), and Suzuki and Sunada (2020) have confirmed the positive results of using interleaved practice in a cumulative schedule to teach grammar. In Nakata and Suzuki’s study (2019), 115 Japanese students were divided into three groups: (1) Blocked practice, (2) Interleaved practice, and (3) Increasing practice (mixing blocked and interleaved practices). The findings showed that increasing practice better enhanced L2 grammar learning and long-term retention than either the blocked or interleaved practice. Moreover, the study of Suzuki and Sunada (2020) investigated the effectiveness of three different practices as well for the acquisition of relative-clause structures. The result indicated that the group receiving hybrid practice outperformed the blocked and interleaved groups in comprehension speed in both immediate post-test and delayed post-test, but outperformed the blocked and interleaved groups in production accuracy only in the immediate post-test.

Methodology

This present study employed a one-group experimental repeated measure design. The independent variable was the English instruction using interleaved practice with a cumulative schedule. The dependent variables were (1) students’ long-term retention of grammatical knowledge and (2) their perception towards the instruction. Apart from quantitative data from a pre-test, immediate post-tests, and one-week delayed post-test, the quantitative

and qualitative data from a semi-structured interview were also included.

Participants

The participants were eighth-grade Thai EFL students studying in a regular program using the Basic Education Core Curriculum B.E. 2551 (A.D. 2008) in the second semester of the academic year 2020. The study was carried out with a purposive sampling technique to select Thai EFL eighth-grade students studying in a private school in Phra Nakhon Si Ayutthaya province. The researchers used the convenience sampling technique to select one intact class out of the three classes that the researchers were assigned to teach. The number of the participants in this research was 23, 10 female and 13 male students with mixed ability in English communication skills and most of them had problems of not knowing the correct forms and not understanding the usage of different English tenses. Moreover, 12 participants from the same intact group were chosen with a simple random technique for the semi-structured interview regarding the perception towards the instruction.

Data Collection

Phase 1: Selecting topics

The researchers selected the two topics — Past Simple and Present Perfect — due to four main reasons: (1) The school curriculum requires 8th Grade students to study English present and past tenses in the second semester; (2) The researchers analyzed the Ordinary National Educational Test of Thailand (O-NET) for students in Grade 9 of the previous year (February, 2020), and it showed that Past Simple tense occurred on the test 94 times, Present Perfect 13 times, Past Simple in the passive voice form 16 times, and Present Perfect in the passive voice form 2 times; (3) According to the literature, the tenses of English persist as the most troublesome grammatical topic found in Thai EFL learners’ output, even though the participants in those studies were all university students (Promsupa, Varasarin, & Brudhiprabha, 2017; Sermsook, Liamnimit, & Pochakorn, 2017). This indicates that Thai students’ problems with English tenses exist already as early as the secondary level, and then simply persist into their tertiary education; and (4) As Kang (2017) and Hughes and Lee (2019) suggest, interleaved practice is the most beneficial and useful when the categories or concepts are, to some extent, similar or confusable, which fits perfectly with both the concept of, and confusion over, the usage of the

Past Simple and Present Perfect tense. These two tenses are similar in which both structures can refer to an event happening in the past, and learners often confuse the two structures (Nakata & Suzuki, 2019; Pan et al., 2019).

Phase 2: Creating instructional instruments and research instruments

1. Instructional instruments refer to lesson plans and teaching materials. This study employed interleaved practice with a cumulative schedule, meaning that the lessons on Past Simple and Present Perfect were already taught to initial mastery and practiced in a blocked format, before using interleaved practice in every third period. The instruction consisted of three units to be taught over 14 periods in 9 weeks. The lesson plans were developed based on the framework suggested by Nassaji and Fotos (2011) on guidelines for developing structured input activities: (1) Keep Meaning in Focus; (2) Present One Item at a Time; (3) Concern with Individual Differences; (4) Move from Individual Sentences to Connected Discourse; and (5) Have Learners Do Something with the Input. Therefore, each lesson plan can be divided into 3 stages: (1) Language Exposure Stage (by providing input and communicative activities for the participants); (2) Noticing and Rule Generalizing Stage; and (3) Language Creativity Stage. The lesson plans were validated by four experts – the head of foreign language department at the school where the present study was implemented and three experts in teaching English as a second and foreign language field. The experienced teacher and experts were asked to check the appropriateness of learning outcomes, content and material, learning condition, assessment and evaluation, and time allotment.

2. Research Instruments in this study consisted of two types: (1) selected-response assessments; and (2) a semi-structured interview.

The selected-response assessments used to collect research data were a grammaticality judgement test and discrimination test. During the implementation of the study, the participants had to take three main tests: a pre-test, three immediate post-tests, and a one-week delayed post-test. The pre-test was designed to assess the students' L2 grammatical knowledge in all three aspects — form, meaning, and use — before enrolling in the research study. The participants were presented with 42 test items—30 items for the grammaticality judgement test, and 12 items for discrimination test. The test items included all aspects of the usage of Past Simple and Present Perfect that were eventually going to be taught during the implementation. The immediate post-tests were held in every third week

of the class schedule. For each test, the participants were presented with 14 test items – 10 items for the grammaticality judgement test, and 4 items for the discrimination test that were parallel with the pre-test. The one-week delayed post-test was identical to the pre-test. The test items on Past Simple and Present Perfect were equally distributed in all the tests.

To verify the validity, the tests were validated by the four experts as mentioned earlier. They were asked to check the appropriateness of the test instruction, content and materials, test condition, and time of the test. For the test reliability, the tests were conducted in a pilot study and were verified using Kuder-Richardson Reliability (KR-20) to find the test reliability. The result of the test reliability was 0.685 meaning that the test had the reliability and could be implemented in the study.

The semi-structured interview was a series of open-ended questions designed to explore students' perceptions and was conducted either in Thai or English according to the interviewee's comfort and preference in order to collect as much information as possible. The semi-structured interview questions were checked and validated by three experts in teaching English as a second and foreign language field. The experts agreed that the questions were appropriate.

Phase 3: Research implementation

The duration of the research design took place in 14 sessions within 9 weeks. The participants firstly had to take a pre-test and then enrolled in the treatment. During the treatment, the participants' grammatical knowledge was periodically assessed by observation during the class time, checking the assignments and giving feedback, and conducting the immediate post-tests. In each blocked lesson, the participants were asked to engage in the communicative activities at the beginning of the class, also called language exposure stage, to answer questions and discuss the language rules during the rule noticing and generalizing stage, and to submit the final draft of the writing task at the end of the class in language creativity stage. In every third week of the lesson, there was an interleaved lesson starting with reviewing the two previous lessons and then the participants were asked to do exercises with interleaved practice design and to discuss the language form, its meaning, and its use. For the last 20 minutes of the class, the participants had to finish the immediate post-test of that unit. One week after having received the treatment, the participants took a delayed post-test, and then 12 participants were chosen randomly to be interviewed at the end of the program.

Data Analysis

In order to explore the extent of interleaved practice with a cumulative schedule on the enhancement of grammatical knowledge long-term retention, the test scores from the pre-test, immediate post-tests, and one-week delayed post-test were analyzed by using repeated measures ANOVA with Greenhouse-Geisser correction and Post Hoc Tests with the Bonferroni Correction.

To examine the participants' perceptions towards the interleaved practice, the qualitative data from the semi-structured interviews were analyzed using the content analysis method. The researchers read the transcriptions for relevant keywords, phrases, or sentences, and identified categories and themes. The categories for the content analysis were developed based on the data obtained.

Results and Discussion

To probe the extent of interleaved practice with a cumulative schedule on students' long-term retention of grammatical knowledge, repeated measures ANOVA with a Greenhouse-Geisser correction and Post Hoc Test using Bonferroni correction and descriptive statistics were used with adjusted time of the evaluation as a co-variable. Table 1 compares the mean scores from before, right after, and one week after the treatment.

A repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean scores differed statistically significantly between time points ($F(1.91, 41.91) = 25.04, p = .000$). The marginal mean, after

adjusted time co-variable, revealed that interleaved practice elicited an increase in scores from the pre-test to the immediate post-test, and then to the one-week delayed post-test (22.52 ± 3.57 points, 28.43 ± 5.04 points, and 29.21 ± 5.29 points, respectively), which was statistically significant ($p = .000$), as shown in Table 1. Post hoc tests using the Bonferroni correction suggested a significant difference in the comparisons between pre-test and both immediate post-test and one-week delayed post-test with a statistical significance as detailed in Table 2.

Based on these statistical outcomes from the grammaticality judgement test, which investigates knowledge of linguistic forms, and the discrimination test, which investigates knowledge of meaning and usage, it can be claimed that interleaved practice has the effect of improving students' grammatical knowledge in all areas: form, meaning, and use. The increase in scores for both the immediate and delayed post-tests indicates the statistical significance of the long-term retention of grammatical knowledge. Therefore, the hypothesis that interleaved practice with a cumulative schedule could enhance the long-term retention of grammatical knowledge of Thai EFL lower secondary students was accepted.

The positive effect of interleaved practice on enhancing the long-term retention of the grammatical knowledge in this study is consistent with the previous studies of Pan et al. (2019), Nakata and Suzuki (2019), and Suzuki, Yokosawa, and Aline (2020), all of which yielded the same result that the interleaved group had higher accuracy scores on the delayed post-test. To the best of the researchers' knowledge, only Suzuki and Sunada's (2020) study did not yield a positive result on

Table 1 The results from repeated measure ANOVA

	Min	Max	Mean Score (<i>SD</i>), points	95% CI	Sig. (2-tailed)
Pre-test	13	27	22.52 (0.74)	20.98, 24.06	.000*
Immediate Post-test	20	39	28.43 (1.05)	26.25, 30.62	
One-week delayed post-test	21	37	29.21 (1.10)	26.92, 31.50	

Table 2 Post-hoc analysis of all test comparison

Time		Mean Difference (points)	<i>SD</i>	95% CI	Sig. (2-tailed)
Pre-Test	Immediate Post-test	-5.91	1.04	-8.62, -3.21	.000*
	One-week Delayed Post-test	-6.70	1.13	-9.61, -3.78	.000*
Immediate Post-test	Pre-Test	5.91	1.04	3.21, 8.62	.000*
	One-week Delayed Post-test	-0.78	0.92	-3.18, 1.61	1.00
One-week Delayed Post-test	Pre-Test	6.70	1.13	3.78, 9.61	.000*
	Immediate Post-test	0.78	0.92	-1.61, 3.18	1.00

the delayed post-test. As this is in line with prior work, it suggests that deliberately and systematically designed practice is an essential stage of developing knowledge and skills in learning languages (DeKeyser, 2007; Nakata & Suzuki, 2019; Suzuki, Yokosawa, & Aline, 2020) and that interleaved practice, therefore, seems to be a useful treatment to be applied in the language classroom.

The advantage of interleaved lessons in a cumulative schedule may be clarified by considering the interleaving effect and the desirable difficulty framework. The interleaving effect happens when intermixed lessons of different new concepts and skills are introduced to the students, and it forces the brain to be active continually due to the rote responses pulled from short-term and long-term memory, which does not happen with the blocked or traditional lessons (Kang, 2017; Hughes & Lee, 2019). Even though there has been research claiming the interleaved practice is more energy consuming and seems to be harder in students' perception, it is reported to bring about better accuracy and long-term retention of the learned knowledge and skills (Rohrer & Hartwig, 2020). For the desirable difficulty framework (Bjork, 1994 cited in Suzuki & Sunada, 2020), it was proposed that knowledge and skill acquisition would occur when the appropriate level of difficulty was provided for the learners. Therefore, when lessons start with the blocked practice, it may help scaffold learning so that learners can understand the necessary fundamental concepts. When the learners' knowledge improves, more challenging practice can be provided to match learners' knowledge and skills. It can thus be theorized that this hybrid schedule with a gradual scaffolding of increasing levels of difficulty aids learning and explains how the statistical significance occurred.

In analyzing the participants' perceptions towards the interleaved practice, two main aspects to the participants' answers came into focus: the positive perceptions, and the negative perceptions. Among the four positive perceptions, "Understand lessons more clearly" was the

comment that was mentioned the most often. On the other hand, there were also participants who reported having negative or somewhat negative perceptions towards the instruction. Among the three negative perceptions, "feel confused and unfamiliar with mixing-topic teaching" was mentioned most often as shown in Table 3.

The literature suggested that most students tend to favor the blocked practice as they perceived studying in interleaved practice design was more difficult and less effective even though their test results showed otherwise (Kang, 2017; Nakata & Suzuki, 2019; Pan et al., 2019; Rohrer & Hartwig, 2020). The results of the semi-structured interviews from this study were partially consistent with the previous studies. However, there were also positive perceptions that the previous studies had not mentioned. The findings indicated the students had both positive and negative perceptions towards the interleaved practice. That the apparently divergent findings of this study are not reflected in previous studies may derive from the time allotment of the treatment. Most of the previous studies were conducted in one or a few sessions, but, for this study, the interleaved treatment was conducted over 14 sessions. Furthermore, upon looking at the interview transcripts more closely, most of the participants reported they also had feelings of confusion, unfamiliarity, and struggle, due to the unfamiliar treatment in the early weeks of the study, but, in time, after becoming familiar with the mixing-topics schedule, they found it useful.

Last but not least, when the individual content of the semi-structured interview of each participant was compared with his or her individual test scores, the researchers found that, interestingly, all of those participants who had indicated that they had positive perceptions towards the interleaved practice, or who had negative perceptions in the beginning but then changed to positive perceptions afterwards, got significantly higher scores on both post-tests. By significant contrast, those participants who indicated that they had completely

Table 3 Students' perceptions towards the interleaved practice

Participants' perceptions	Frequencies
Positive perceptions towards interleaved practice	
1. Understand lessons more clearly	10
2. More opportunities to practice English	9
3. Remember the lessons better	5
4. Fun and not boring	5
Negative perceptions towards the interleaved practice	
1. Feel confused and unfamiliar with mixing-topic teaching	8
2. More difficult to understand	5
3. Easy to forget the lesson	3

negative perceptions that remained unchanged throughout the entirety of the study also had insignificantly improved test scores. Rohrer and Hartwig (2020) stated that blocked practice might produce a sense of fluency and confidence whereas interleaved practice might reduce them. This intriguing detail can be interpreted whereby interleaved practice might be suitable for students who are a bit more risk-takers and who love challenges so that they feel eager to overcome the more difficult tasks; on the other hand, blocked practice might be suitable for students who prefer passive teaching and need support on confidence issues.

The findings from the present study suggested the following pedagogical implications. 1) The schedule design can also be planned due to the ability and readiness of the students. The lessons designed with purely interleaved practice may suit students who have some background and enough knowledge as Kang (2017) mentioned that interleaved practice should be provided for the learners of at least intermediate level. This lesson design is important for the students because interleaved practice is somehow like a simulation of real-world communication, whereby the students cannot expect to use only one aspect of concept or skill in order to complete the task. On the other hand, interleaved practice with a cumulative schedule, also called increasing practice or hybrid practice, may be more suitable for students who are new to L2 and still need solid fundamental concept and skills before being challenged with another level of difficulty simulating the use of the language in the real world. The mixing between blocked and interleaved would scaffold learning and increase students' confidence in the use of the new language. 2) Additionally, a number of studies in many aspects of English communicative skills have revealed the advantages of interleaved practice over traditional lessons (Nakata & Suzuki, 2019; Pan et al., 2019; Suzuki & Sunada, 2020). English instruction using interleaved practice can be implemented in any kind of English courses, not only for the lessons aiming to help students focus on both meaning and form as the FFI lessons done in this research, but also for other skills such as listening, speaking, and writing. It is noteworthy that interleaved practice can be adapted to implement with all communicative skills.

Conclusion and Recommendation

This study revealed two findings. Firstly, the quantitative data confirmed the desirable effects of the

interleaved practice with a cumulative schedule on the long-term retention of the grammatical knowledge. After the treatment, the results showed statistically significant improvement at both the immediate post-tests and the one-week delayed post-test. Secondly, the data obtained from the semi-structured interviews disclosed both the positive and negative perceptions that the interleaved practice seemed to be harder and more exhausting at first, but after getting familiar with it, the interleaved practice was preferable.

There were some limitations of the study that may have affected the findings. 1) This study was implemented for only 14 periods in 9 weeks and in order to have more insightful information on the effects of the interleaved practice, time allotment could be extended to be a whole semester or academic year. 2) The pre-test and one-week delayed post-test were identical while the immediate post-tests were the parallel ones. Consequently, the use of two different sets of tests might affect how the delayed post-test scores were higher than the immediate post-test. 3) Moreover, as the participants of this study were purposively selected with a limited number of participants, it might not be possible to make a generalization onto population groups who do not share the characteristic of the participants in this study.

To the best of the researchers' knowledge, studies on the effects of interleaved practice with participants studying in junior and senior secondary levels are scarce, as are studies on the effects of interleaved practiced with a variety of other linguistic topics; most research on interleaved practice has so far only been done using the aspect of tenses in different languages. Moreover, the lessons in this study were designed using interleaved practice in a cumulative schedule only. Future studies could also be done separately on interleaved practice alone and on the cumulative schedule alone, and then comparison studies done to disambiguate which practice better improves participants' knowledge and long-term retention.

Conflict of Interest

There is no conflict of interest.

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