Student Study Habits and Metacognitive Assessments of Learning Strategies

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学生の学習習慣と学習方略に関するメタ認知

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ABSTRACT

Students' metacognitive judgements of learning are not always accurate. It is imperative that students can identify and use study methods that lead to real learning rather than use methods that provide an illusionary sense of having acquired some new knowledge. A modified version of McCabe's (2011) study examined university undergraduates' a priori assessments of the effectiveness of various learning scenarios. The scenarios used were based upon empirically proven effective study strategies drawn from the cognitive psychology literature on learning. A second phase of the study examined how the students develop or decide upon the learning strategies that they employ. That is, do they rely upon intuition and improvisation in developing their approach to learning or are their study strategies a result of direct instruction. Some of the methods presented are counter-intuitive and may not be widely known by students or their teachers; however, a knowledge of the methods has been associated with improved long-term retention (Weinstein et al., 2018). The present study found that students are not significantly aware of effective learning strategies. This finding was not surprising; however, what they did accurately endorse differed from what American students feel is beneficial.

Keywords: learning strategies, learner development, metacognitive judgements of learning

1. Introduction

One doesn't master a language, or anything else for that matter, through a single class per week. Mastery learning requires concerted effort outside of guided classroom instruction. This autonomous learning is essential, but how do students develop maximally effective and efficient methods of study? Inefficient and ineffective learning strategies lead to negative perceptions of one's ability to achieve the goal at hand. Previous research on student study strategies carried out in the United States context (Karpicke et al., 2009) has shown that students generally adopt less effective study strategies and eschew strategies that have been empirically demonstrated to be more effective. For students to have agency over their learning, it is essential for them to be able to discern what effectively promotes learning from what merely feels like effective learning. The ability to come to an accurate metacognitive judgement of learning (JOL) is at the core of learners' ability to learn effectively (Pashler et al., 2007).

The term metacognition was first coined by the developmental psychologist John Flavell where he defined it as "one's knowledge concerning one's own cognitive processes or anything related to them, e.g., the learning-

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relevant properties of information or data" (1976; quoted in Tanner, 2012, p.113). In more recent publications aimed at informing teachers on maximally effective practice, metacognition has been further divided to include three ongoing processes: planning, monitoring, and evaluation (Quigley et al., 2019). The first phase of the process involves considering where one is at present and then reflecting on what learning strategy will most effectively help one to get where they want to be and planning how to implement that strategy. In the second phase of the cycle the learner puts their plan into action and actively reflects on the progress of their learning. The third phase is where the learner updates their knowledge of self and modifies their assessment of the effectiveness of the strategy used. In an effective learning program, these are not discrete stages; instead, they form an ongoing process that continuously cycles and repeats.

In order to effectively initiate the planning phase of the metacognitive cycle presented above, learners need to be able to choose learning strategies that will help them to achieve their goals. In a study of student judgments of learning and influences on study habits, Kornell and Bjork (2007) found that 80% of students improvised the study strategies that they chose. That is, they are not using strategies that have been provided by some authoritative source such as a study guide or teacher. Some learning strategies are not intuitive (e.g., interleaved study), so students may not naturally select such a method without direct instruction. One factor that has been shown to influence students' assessment of the effectiveness of a study method is the perceptual fluency that the students experience as they progress with study (Hertzog et al., 2003; Kornell, 2017)). An example of this can be seen with the study strategy of reading and then re-reading material (Karpicke et al., 2009). The subsequent re-reading of a text is easily comprehended, and thus students have a positive self-assessment of their knowledge of the material.

To assess which strategies students deem more effective while avoiding the erroneous judgment of learning influenced by perceptual fluency, Jennifer McCabe (2011) conducted a study on 255 undergraduate students to assess their metacognitive awareness of six empirically-supported learning strategies. The study presented the students with paired hypothetical learning situations. In each pair, one of the scenarios described an empirically supported learning strategy contrasted with one that has not been supported in the research literature. She then asked the students to assess via a 7-point Likert scale which of the two scenarios would lead to better test scores. Her study revealed that, in general, students were not able to accurately predict which learning strategies were more effective when presented with descriptions of paired learning scenarios and which scenario would result in better test scores. Section 1 of the current research is a slightly modified replication of McCabe's study of students' a priori impressions of effective learning strategies.

The first part of the present research utilizes a similar design with students being asked to read paired descriptive scenarios of learning strategies in practice and to make an assessment as to which they feel is the better strategy. The question form presented to the students differs in that it asks students a pair of questions for each set of scenarios, (1) which way they feel that they would prefer to study, and (2) which study method do they think would be more effective.

The paired scenarios were each based upon empirically supported effective learning protocols, and the scenarios were written in such a way as to avoid direct mention of a particular method to avoid a key word suggesting to a student which choice to make without the student fully considering the situation.

The six study methods can be divided into two overall groups: strategies that are related to cognitive load theory (Sweller et al., 2011) and strategies associated with desirable difficulties (Bjork & Bjork, 1992). The first three scenarios relate to cognitive load theory. Briefly, cognitive load theory is rooted in an understanding of the limitations of working memory. Miller (1956) famously presented the number 7±2 as the capacity of the number of chunks of information that could be held in working memory at a given time. More recently, Cowan et al. (2001) have found the number to be 4±1 to be the number of items that can be manipulated within working memory. The severe limitation in capacity has prompted Sweller et al. to say, "The implications of working memory limitations on instructional design can hardly be overestimated .... Anything beyond the simplest cognitive activities appear to

overwhelm working memory. Prima facie, any instructional design that flouts or merely ignores working memory limitations inevitably is deficient" (Sweller, van Merrienboer & Paas 1998, pp. 252-253). Cognitive load theory identifies three types of load that occupy working memory. The first is intrinsic load. This load is the necessary load that is inherent in the subject matter being studied. The degree of load is related to two factors, the complexity of the subject matter and the prior knowledge of the student. That is, something that is well known does not introduce a significant load to the expert, but the same objective material would pose a considerable load to the relative novice. Another form of cognitive load is extraneous load. This is the unwanted/non-productive load that may arise from external or internal factors that occupy some part of working memory but do not contribute positively to the learning. Some teaching practices can significantly contribute to the extraneous cognitive load of the student and thus would have a negative impact on learning outcomes. The third form of cognitive load is germane load. This is the load that results from the process of learning and development of schema (Sweller, van Merrienboer & Paas 1998). These three forms of cognitive load are considered to be additive, and they should not exceed the limited capacity of working memory. Should working memory be exceeded, a state of cognitive overload is reached, then learning is impeded, and incorrect schema may be developed (Feldon, 2007). Dylan Wiliam has described cognitive load theory as "the single most important thing for teachers to know" (Wiliam, 2017).

The first of the paired scenarios for the students in the questionnaire is dual-code vs. single-code presentations of material (Mayer & Anderson, 1992; Kalyuga et al., 1999). The dual-code refers to utilizing both visual and verbal input channels to the brain (Paivio, 1986). The two forms of input are additive and result in an increase in working memory capacity. This is possible because the underlying systems are posited to be processed by separate systems (Baddely, 1992).

The second pair of the scenarios presented is based on the difference in static vs animated media. One prediction arising from cognitive load theory is the static-media hypothesis. This states that animated media such as video add a greater level of load than static visuals such as still pictures. This may arise due to the increased amount of extraneous detail presented in animated visuals (Mayer et al., 2005). The hypothesis suggests that still presentation of visuals will result in improved learning due to the decrease in extraneous cognitive load and the resulting increase in working memory available to process the germane cognitive load.

The third pair of scenarios is derived from the exploration of including low-interest vs. high-interest details in learning materials. Additional irrelevant information, although interesting, represents extraneous cognitive load, and thus it is hypothesized to use more of the limited processing capacity than would have been used had the interesting details been excluded. As with the other cognitive load related scenarios, a reduction in the available working memory capacity results in a reduction in processing capacity for intrinsic and germane cognitive loads and a concomitant reduced capacity for learning.

The next three of the paired scenarios are related to a theory by Robert Bjork called the new theory of disuse (Bjork & Bjork, 1992; Bjork, 2012). This theory posits the relationship and interaction of two aspects of memory, storage and retrieval, and strives to explain how long-term memory storage is seemingly limitless while the ability to access memories contained within long-term memory can be difficult to retrieve and are prone to lapses (Bjork, 2012).

In the new theory of disuse, each memory has two strengths: a retrieval strength (a measure of the accessibility of the memory) and a storage strength (the degree that a memory trace is consolidated in long-term memory). These two are related in that items that have a high retrieval strength (e.g., what you have recently considered) may have a weak storage strength (i.e., you will not be able to recall this thought next year). Conversely, some things that were once known very well (e.g., the telephone number of your best friend during childhood) may be near impossible to recall now. Of course, given the appropriate cues, it may be possible to recall the memory, for it most likely still exists. During study or practice, both the storage strength and the retrieval strength of a trace increase; however, the greater the level of retrieval strength during that study, the less the storage strength will gain.

Robert Bjork summed up the relationship by saying, “When something is very, very accessible right now, virtually no learning can happen” (Bjork, 2012).

This interplay between retrieval and storage relates to what Bjork has termed “desirable difficulties” (1992). Simply, by adding challenge, i.e., a difficulty that results in some reduction in retrieval strength, subsequent study sessions or exposure to the study material will result in an increase in storage strength. This increase in storage strength is a direct correlate with an increase in long-term memory, i.e., learning.

The fourth group of paired scenarios contrasts testing vs restudying. This pair relates to a well-known effect in cognitive psychology, the testing effect, which was first described in 1917, and has recently enjoyed an increase in attention (Roediger, Putnam, & Smith, 2011). The testing effect states that the learning and memory of some material are improved through the act of testing oneself on that material (Roediger and Karpicke, 2006). This is testing for learning and consolidation as opposed to testing for assessment. Karpicke et al. (2011, p.772) wrote, “Not only does retrieval produce learning, but a retrieval event may actually represent a more powerful learning activity than an encoding event.”

The fifth pair of scenarios contrasted spacing vs massing study sessions. The positive learning effect associated with this pair is the spacing effect. Spacing practice over several study sessions (known as spaced practice or distributed practice) has been known to be a powerful method of learning since Ebbinghaus (1885/1913) demonstrated how distributed practice allowed him to improve the efficiency of his learning by attaining the equivalent level of learning usually achieved in sixty-eight study cycles in only thirty-eight study cycles through spacing the study sessions across three days as opposed to completing the study in one massed session (Roediger, 1985). Spaced practice is distributing the study of the same information over time in multiple study sessions. This form of study is contrasted with massed practice, which is the covering of an amount of material in a single study session (Weinstein et al., 2018).

The sixth pair of learning scenarios, generating vs. non-generating, is based upon the generation effect. This effect states that materials created by the learner will be more easily remembered than those materials provided by the teacher (Jacoby, 1978).

Section 2 of the questionnaire used in the current research examines what study methods the students use when studying. In similar studies of American students, Miyatsu et al. (2018) found that the most frequently used study strategy was re-reading at 78%. The next two most popular study strategies were using flashcards (55%) and highlighting (53%). In another study carried out by Karpike et al. (2009), 84% of students free-reported using re-reading as a primary study strategy. By comparison, only 11% of students said that they used self-testing as a study strategy.

The fourth section of the current research looks at how the student research subjects developed the study strategies that they employed. In Kornell and Bjork’s (2007) study, 80% of the students reported that they had not had any formal instruction on how to study or information on what were more or less effective study strategies. Therefore students were left to improvise study habits based upon personal impressions of what works best even if these perceptions are frequently biased by current performance and are not grounded in how much real learning has taken place (Kornell & Hausman, 2017). For example, when students re-read a passage, the perceptual fluency of the familiar material leads to a high level of performance and, subsequently, a higher perception of learning. The problem is that the ease of recognition does not guarantee that effective learning has taken place.

2. Methods

2.1 Research Questions

This study had five research questions that it sought to gain some clarification on. These questions were:

1. How accurately can students identify more effective learning/study strategies?

2. Are there occasions when there is a difference in what a student feels is effective vs. what study form they would rather do?
3. Of the six pairs of scenarios, which ones were the students most accurate in endorsing?
4. What study strategies/methods do the students most frequently use?
5. How did the students develop/learn their study strategies?

2.2 Hypotheses

Based upon the literature (McCabe, 2011), I suspected that many students would not correctly identify the more effective learning strategies. With question 2, I felt that there might be occasions in which the students identified a study strategy but indicated that they would prefer not to use this method in their personal study practice. As with the other studies cited in the review of the literature (e.g., Karpicke et al., 2009), I suspected that re-reading would be the most popular strategy and that strategies requiring more challenge such as self-testing would not be popular. Having seen little evidence of effective study skills training being conducted in Japan, I had little reason to doubt that the results of Section 4 of the questionnaire would reveal that student study strategies would be improvised.

2.3 Context

The questionnaire was given to first- and second-year students (N=802) enrolled in general English classes at a mid-sized private university in semi-rural Japan. Of the 802 questionnaires collected, twenty-nine had not been fully completed, or the consent to participate in the research form had not been properly signed and dated and thus had to be excluded from the final data analyses. Eliminating these twenty-nine forms left 773 completed questionnaires to be analyzed.

All participants were asked to volunteer to participate in the research, and no compensation or reward was provided for their participation. The participants were provided with a consent to participate form, written in Japanese, outlining a brief description of the study and outlining their right to refuse to participate and/ or withdraw from the study at any point without the need to provide a reason and without penalty. Further, they were explicitly informed that their data and identity would remain confidential. No data on age, gender, or grade point averages were collected.

2.4 The Research Tool

The research tool (see appendix 1) for this study was a paper questionnaire written in Japanese. The questionnaire was divided into four sections. The first section presented six pairs of descriptions of studying. Each pair contained one method that has been empirically supported as being more effective at promoting learning. The scenarios were carefully written to avoid any direct mention of the strategy being examined. Following each pair, the students were asked: “Which, (A) or (B), would you prefer to study?” and “Which, (A) or (B), do you think would help you learn the best?” The six scenarios explored the following areas: Scenario 1- dual-code vs. single-code presentation, Scenario 2- static vs. animated media, Scenario 3- low-interest vs. high-interest details, Scenario 4- testing vs. restudying, Scenario 5 – spaced study vs. massed study, Scenario 6- generated vs. non-generated materials.

In each of the pairs listed above, the more effective is listed first; however, on the questionnaire, the order of presentation to the students was random.

The second section of the questionnaire asked students to rank the five most frequent methods that they use to study, with five being most frequently used and one being least frequently used of those identified. Eight choices were provided to the students: re-read, highlight important sections, self-test on key facts/ information, copy the study text into a notebook, record yourself reading the text and listen to it, make cue cards/index cards, study in

front of the television/ while watching videos, and summarize the text in your own words. A ninth choice provided the students with the option to select “other” and then write their addition.

The third section contained two questions. The first asked students to identify if they study more or less than their peers. The second asked students to write, in hours/minutes, how long they study during an average week.

The fourth and final section of the questionnaire asked students to identify how they developed/learned their study habits. They were directed to select all of the options that applied to them. The options provided were: “I learned study methods from books,” “My teacher taught me how to study,” “My friends taught me how to study,” “I learned study methods from the Internet,” “I learned study methods in a study skills course,” and “I developed the study methods myself. Nobody taught me.” As with Section 2, a seventh choice provided the students with the option to select “other” and then write their addition.

2.5 How the Data were Analyzed

The questionnaire responses were recorded, and descriptive statistical analyses were conducted. Regression analysis was also conducted using the statistical softwares STATA and Wizard.

3. Results

The first of the research questions sought to determine how accurately students could identify more effective learning/study strategies. As can be seen in Figure 1, most of the students were able to correctly identify and endorse some of the effective strategies; however, only a combined 9.6% total could endorse more than half of the strategies. This could stem from the fact that some of the learning strategies were more intuitive than others, for example massed.

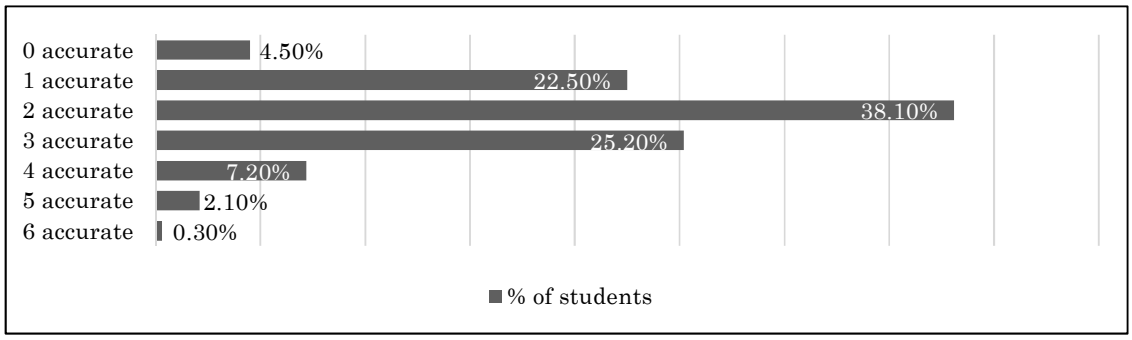

Figure 1. How correctly could the students identify effective study/learning strategies
[The number of accurate endorsements of the second of the paired questions, i.e., “Which, (A) or (B) would help you learn the best?]

The learning strategies that the Japanese undergraduate students who participated in the current study accurately endorsed after reading the study scenarios were quite different to the ones endorsed in the McCabe study, which also involved undergraduate students. In this study (see Table 1) the strategies of low- vs. high-interest details and spaced vs. massed study were much more accurately endorsed by the students than they were by those in the McCabe study. Conversely, the strategy of generating vs. non-generating materials oneself was much more accurately endorsed by the students in the American context.

Table 1. Strategies endorsed
[Student endorsements of the learning strategies in the current study (top) were quite different to those in the McCabe (2011) study.]

	Dual vs. Single code	Static vs. Animated	Low- vs. high-interest	Testing vs. Re-studying	Spaced vs. massed study	Generating vs. non-generating
This study	59.2%	16.6%	70.6%	24.3%	25.9%	18.8%
McCabe, 2011 study	37.8%	22%	32.7%	32.7%	9.6%	53.3%

The second of the research questions contrasted what students would prefer to do with what they think would lead to a better outcome. Were a student to endorse these two considerations equally, it would suggest that they would want to study in the manner that they felt was most effective. As is apparent in Figure 2, students accurately endorsed the less effective strategy when it related to how they would prefer to study less often than they accurately endorsed the effective strategy when it related to which method they felt would be more effective.

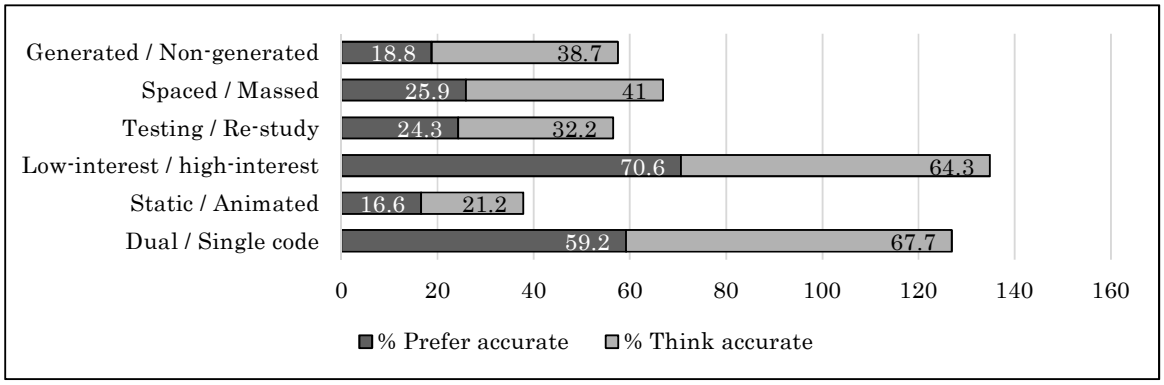

Figure 2. Accurate endorsement: Prefer to study and think effective
[The numbers of students accurately endorsing each of the study/learning strategies was not balanced. Of the six strategies, two were more accurately endorsed than the others.]

Of those strategies identified by the students as less preferable to use as a study method, the two with the greatest disparity were spaced vs. massed study and generating vs. non-generating materials (see Table 2). These two methods are methods that are described as desirable difficulties (Bjork, 2012) so it is possible that this difference may relate to that difficulty.

Table 2. Student preference versus perceived effectiveness
[The difference of student endorsement of what strategies they would prefer to do and the degree of endorsement for how effective they feel the strategy would be at improving learning. A negative value indicates that the students perceive the strategy as more effective than their desire to use that strategy.]

	Dual vs. Single code	Static vs. Animated	Low- vs. high-interest	Testing vs. Re-studying	Spaced vs. massed study	Generating vs. non-generating
Prefer to do (A)	59.2%	16.6%	70.6%	24.3%	25.9%	18.8%
Think is better (B)	67.7%	21.2%	64.3	32.2%	41%	38.7%
The difference of (A) minus (B)	-8.5%	-4.6%	6.3%	-7.9%	-15.1%	-19.9%

Section 2 of the questionnaire (Appendix 1) aimed to provide insights to answer the fourth research question; that is, what study strategy/method do the students most frequently use? Of the study methods shown in Figure 3, two (highlight and re-read) are the most popular.

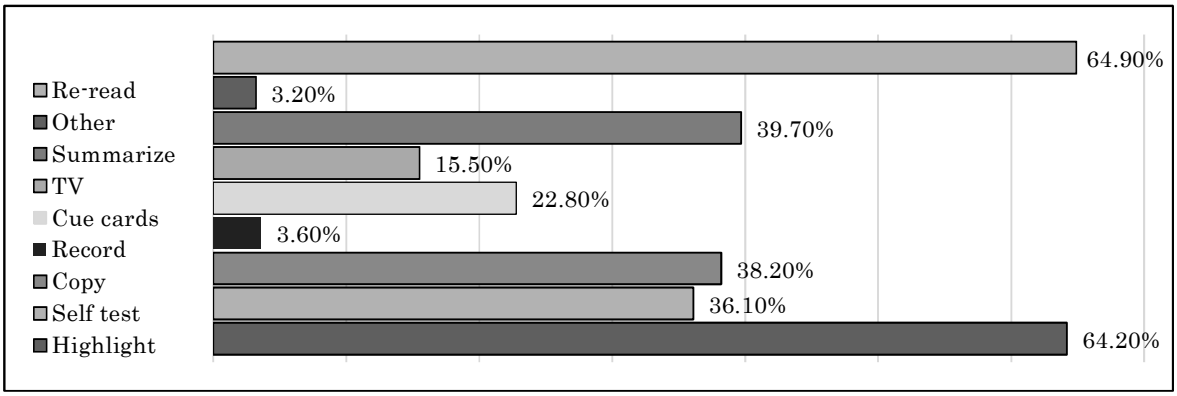

Figure 3. Combined scores of the most frequently used study methods (items ranked 4 or 5)
[The nine choices presented to the students and their self-reported usage. The most used strategies were in-line with the choices of other students in different contexts.]

Section 3 of the questionnaire (see Appendix 1) asked if the students feel that they study more or less than their peers. The vast majority of students responded that they study less than their peers. The degree to which this was reported may come as a surprise; however, another question in Section 3 asked students to provide a rough average of how long (in minutes and hours) they study per week (all subjects combined). The mode of time spent studying per week (in minutes) was 60. Fully, 74 respondents (of 773) reported that they studied zero minutes per week and 142 reported that they studied less than 60 minutes. Although there were a few outliers who study a lot, 90% of the students reported studying 8 hours per week or less. At 11 hours per week of study 96% of the students can be included.

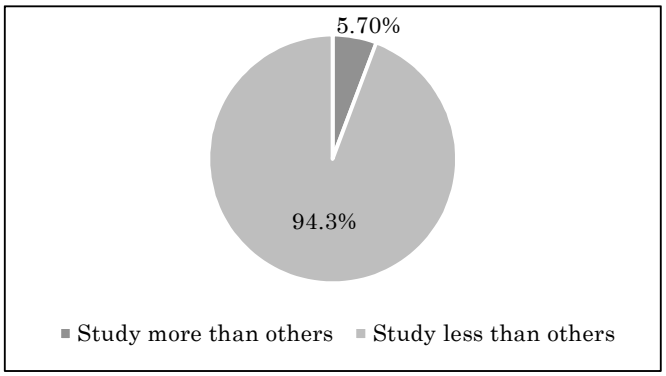

Figure 4. Student self-assessment of study amount
[The student self-report on how they study relative to their peers reveals that students are not aware of how their study volume compares to others.]

The fifth research question and question within the research tool examined how the students developed or learned their study habits. They were encouraged to select all of the sources that they have used. Figure 5 shows that two are two main avenues by which students acquire their study habits: teachers (49.5%) and self-teaching (41%) (i.e., improvisation). A statistical regression was carried out to determine if any of the sources listed was predictive of accurate endorsements of the learning strategies. The only correlation that existed was weak and it was that learning study strategies from books weakly predicted an accurate endorsement of the learning strategy testing vs. restudy. The *p*-value of this relationship was $p = 0.021$ against the null.

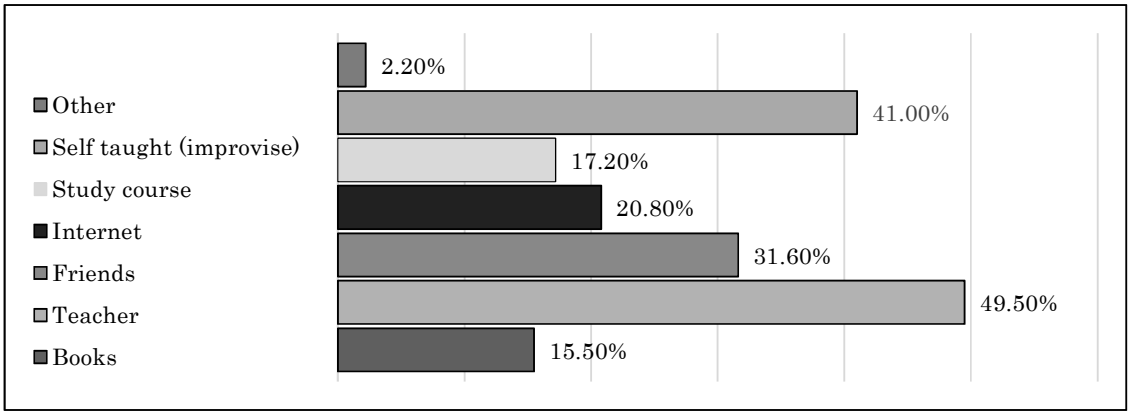

Figure 5. Students self-reported source of learning / developing study habits
[A large percentage of students do not take full advantage of the many sources available to them to assist their acquisition of learning strategies. Also, the strategies that they do use, may not fully accurate in the advice given.]

4. Discussion

4.1 Discussion of the Results

Overall, the finding that students were not very accurate in their metacognitive assessments of the learning styles examined in this study was not a surprise. Looked at broadly, it is very much in line with what others have found (McCabe, 2011; Kornell & Bjork, 2007). When what was accurately endorsed and what was not is looked at more closely (Table 1), it is interesting to note that what students within the context of the current study, i.e., Japan, correctly identified was markedly different to what the students in McCabe's (2011) study endorsed in an American context. Perhaps this relates to the forms of instruction and/or the assessment that each group has received thus far in their education. For example, as constructivist teaching becomes more prevalent in western contexts (Mordechi, 2009), it is possible to hypothesize that it would influence students' strong endorsement of using generation as a learning strategy (53.3%). In Japan, where direct instruction is prevalent, the students gave generation of materials their second-lowest endorsement at 18.8%. Of course, other possible explanations could account for this disparity, and it does warrant further study.

The two strategies that received the most accurate endorsement from the participants in the current research were using low-interest details and dual-code presentation (see Figure 1). Of the six choices, these two are both related to cognitive load theory. Specifically, they are strategies that reduce extraneous cognitive load. Lowering processing load or challenge would be something that students may be able to sense and consider positively. This is especially true if the students were not academically strong. Data on the grade point averages (GPA) of the students or any IQ data that would inform a hypothesis on the relationship and strategy preference with the cognitive capacity of the study participants were not collected, so it is not possible to draw any connection beyond a hypothetical one.

The three learning strategies associated with desirable difficulties (i.e., generated materials, spaced practice, and self-testing) were not accurately endorsed in the measure of if the students would prefer to use that method for study. In each of these strategies, the appraisal for the effectiveness was greater than their appraisal for if they would actually like to use that study method. This avoidance of challenge in using study strategies that involve desirable difficulties is a pattern that has been seen in other research (Weinstein et al., 2018). Students who have been shown to perform better under a desirable difficulty study protocol have protested and insisted that the non-desirable difficulty protocol was superior despite being presented with clear evidence to the contrary (Kornell & Bjork, 2008).

Further support that students have a preference for study strategies that do not provide challenge and instead provide a sense of familiarity can be seen in the answer to research question four. This fourth question, drawing from the data derived from Section 2 of the research tool, looked at the most frequently used methods of study that the students use. As can be seen in Figure 3, re-reading (64.9%) and highlighting (64.2%) were the most popular strategies selected. These two do not really require thought because when material is looked at in subsequent occasions, the perceptual fluency of revisiting the text gives a feeling of familiarity, which in turn biases the student's judgement of learning. In short, they think they know the material, but they may not. The new theory of disuse (Bjork & Bjork, 1992; Bjork, 2012) suggests that real learning is not happening. More challenging forms of study (e.g., self-testing and using cue cards), which have been shown to be more beneficial, are less used by the students.

Research question 5 asked what study/learning strategies the students most frequently use. In line with the vast majority of the research that explored this question in other contexts (Kornell & Bjork, 2007), the students in this study selected self-taught (41%) as one of their primary means of developing study strategies. Because students' metacognitive judgement of learning is not very accurate, this improvisation of study methods is likely not to be maximally efficient or effective. The one source that was more highly selected was learning from a teacher (49.5%). At first, this may seem like a secure source of knowledge on effective study strategies; however, this may not be the case. In a survey of teacher awareness and usage of effective learning strategies conducted in Japan, Lowes (2017) found that most teachers had never formally heard of most of the strategies. This was not surprising as studies carried out by Pomerance et al. (2016) and Surma et al. (2018) have found that very little information about effective learning strategies is included in textbooks used in teacher training courses. To that end, although the most common source of student information on study practices does come from teachers, this does not mean that the quality of the information rose much above 'study hard' or 'study more'.

Although applying more hours to study may not always be the best advice for the students in the current study, it may be something for them to consider doing. With a little over one third (35.8%) of the students indicating that they study less than one hour per week, it does seem that any approach to study would be an improvement. However, the lack of motivation to study may actually be a symptom of an adverse metacognitive reaction to ineffective study practices. It is understandable that someone who felt that they were working hard but not having positive results would eventually conclude, at some level, that study was a useless Sisyphean endeavor. Were the students to learn effective study strategies and experience success, it is possible that their metacognitive assessment of study might change for the better.

If students develop effective learning strategies and have the metacognitive awareness to plan and implement effective courses of study, it will help them to advance toward their personal goals. In the undergraduate group in the current study, more work is needed to bring them to that level. Since autonomous learning is the means to success, improving the metacognitive awareness of students is a goal that education programs should strive to attain.

Some limitations of the current research were that no objective assessments of the working memory capacity of the students were made; therefore, the role that working memory plays in the accuracy of metacognitive judgements of learning could not be evaluated. Nelson and Narens (1990, 1994) divided metacognition into two levels of analysis: object-level and meta-level. These levels fit well with Baddeley's (2015) four component model of working memory where the central executive (i.e., the meta-level) monitors the information available in the visual-spatial sketchpad, the episodic buffer, or the phonological loop (i.e., the object-level). Further research should explore the relationship between working memory capacity and metacognitive awareness of effective learning strategies.

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Appendix 1. The Research Tool

勉強について学生はどう考えているか

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Section 1

下記(A), (B)の勉強の行われる状況を読み、それぞれについて問 1 と問 2 に回答しなさい。

Scenario 1

(A) 授業で学習する二つのトピックがあります。一つ目は、静止画とそれを音声で説明する形で提示されます。	(B) 二つ目は、静止画とそれを文章で説明する形で提示されます。

問 1：(A)と(B)のうち、あなたはどちらを（で）勉強したいですか。_____

問 2：(A)と(B)のうち、どちらがあなたの学習に一番役立つと思いますか。_____

Scenario 2

(A) 授業で学習する二つのトピックがあります。一つ目（燃焼機関の仕組み）は、説明のナレーション付きのビデオ動画を使って提示されます。	(B) 二つ目（電動機の仕組み）は、説明のナレーションとともに一連の静止画を使って提示されます。

問 1：(A)と(B)のうち、あなたはどちらを（で）勉強したいですか。_____

問 2：(A)と(B)のうち、どちらがあなたの学習に一番役立つと思いますか。_____

Scenario 3

(A) 学習する二つのトピックがあります。一つ目は、ウイルスがいかに人々に感染するかについての基本事実を説明します。それはまた、ウイルスの大きさ、スピード、そして頻発について情報を提供します。	(B) 二つ目は、細菌はいかに人々に感染するかについての基本事実を説明します。それはまた淋病と梅毒のような性感染病についての情報を提供します。

問 1：(A)と(B)のうち、あなたはどちらを（で）勉強したいですか。_____

問 2：(A)と(B)のうち、どちらがあなたの学習に一番役立つと思いますか。_____

Scenario 4

(A) あなたが受けている授業の一つの教科書には、各章末に復習問題があり、答えを探さないで解答するようにとの指示があります。	(B) 別の教科書では、各章末に復習リストがあり、再読すべき重要ポイントが示されています。

問 1：(A)と(B)のうち、あなたはどちらを（で）勉強したいですか。_____

問 2：(A)と(B)のうち、どちらがあなたの学習に一番役立つと思いますか。_____

Scenario 5

(A) あなたは英文法を練習するためにスマートフォン・アプリの購入を考えていま	(B) 別のアプリでは、練習問題に種々の文章構造が混ぜ合わされています。

す。購入検討中の一つのアプリには、練習問題が文法構造ごとに整理されています。	

問 1：(A)と(B)のうち、あなたはどちらを（で）勉強したいですか。_____

問 2：(A)と(B)のうち、どちらがあなたの学習に一番役立つと思いますか。_____

裏に続く

Scenario 6

(A) あなたは英語の授業で、一連の等位接続詞を覚えなくてはいけません。この授業の先生は、等位接続詞は FANBOYS と覚えるといいと教えてくれます。	(B) あなたは別の授業でもまた、一連のリストを覚えないといけません。この授業の先生はあなたにそのリストを覚えるために役立つ記憶法を自分で考えるよう求めています。

問 1：(A)と(B)のうち、あなたはどちらを（で）勉強したいですか。_____

問 2：(A)と(B)のうち、どちらがあなたの学習に一番役立つと思いますか。_____

Section 2

下記に挙げられた勉強法について、あなたが勉強に最もよく使う方法を 5 つ、5〜1 までランク付けしなさい。

5= 最もよく使う **1= あまり使わない**

____読み返す ____重要箇所にマーカーを引く ____重要な事実／情報を自己テストする ____勉強したテキストをノートに写す ____ テキストを読んで録音し、それを聞く	____暗記カード／情報カードを作る ____ テレビの前で／ビデオを見ながら勉強する ____学んだ内容を自分の言葉で要約する ____他の方法（具体的に示しなさい）_____

Section 3

次の問いに答えなさい。

他の学生と比べて、自分の勉強量は多いと思いますか、少ないと思いますか。

（多い　　少ない）

一週間平均的にどの位の時間勉強していますか。（答え＝　　時間・分）

Section 4

あなたはどのようにしてあなたの勉強習慣を身に付けていきましたか・学びましたか。合致するものを全て選びなさい。

____ 私は勉強習慣を本から学んだ。

____ 私の先生が勉強の仕方を教えてくれた。

____ 私の友達が勉強の仕方を教えてくれた。

____ 私はインタネットから勉強方法を学んだ。

____ 私は勉強法の授業で勉強習慣を学んだ。

____ 私は勉強方法を自分で身に付けた。誰からも教わっていない。

____ 他の場合（具体的に示しなさい_____