The Canadian Journal for the Scholarship of Teaching and Learning

Volume 16 | Issue 1 Article 18

Summer 08-31-2025

An Examination of Canadian Post-Secondary Faculty Beliefs Concerning Learning Strategies

Derek Newman
Cambrian College, derek.newman@cambriancollege.ca

Follow this and additional works at: https://www.cjsotl-rcacea.ca
https://doi.org/10.5206/cjsotlrcacea.2025.1.18641

Recommended Citation
Newman, D. (2025). An examination of Canadian post-secondary faculty beliefs concerning learning strategies. *The Canadian Journal for the Scholarship of Teaching and Learning, 16*(1). https://doi.org/10.5206/cjsotlrcacea.2025.1.18641

An Examination of Canadian Post-Secondary Faculty Beliefs Concerning Learning Strategies

Abstract
Students make many decisions in academia concerning learning. One of the most critical among them is what learning strategy to use. This research surveyed faculty members from various Canadian colleges and universities to examine their opinions on the effectiveness of different learning strategies. Although the results were mixed, the overall finding showed a discrepancy between faculty opinions and best evidence. Several demographic factors were examined (for example, the faculty's highest degree, employment status, number of years teaching, subject taught, and institution type), but none was a meaningful predictor of faculty opinions regarding learning strategy effectiveness. Even though faculty opinions were not in line with recognized evidence, their views provide insight into the learning strategies perceived as beneficial and those that students may be using. Learning is a complicated process that can be affected by numerous factors. Hence, this paper reports on the opinions of Canadian faculty concerning learning strategies that facilitate this process and presents plausible theories to explain the disconnect between their views and the best evidence.

Les étudiants et les étudiantes prennent de nombreuses décisions dans le milieu universitaire concernant leur apprentissage. L'une des plus importantes est le choix de la stratégie d'apprentissage à adopter. Cette étude a interrogé des membres du corps professoral de divers collèges et universités canadiens afin d'examiner leur opinion sur l'efficacité des différentes stratégies d'apprentissage. Bien que les résultats soient mitigés, les conclusions générales ont montré un écart entre l'opinion des enseignants et des enseignantes et les meilleures preuves disponibles. Plusieurs facteurs démographiques ont été examinés (par exemple, le diplôme le plus élevé des enseignants et des enseignantes, leur statut professionnel, leur nombre d'années d'enseignement, la matière enseignée et le type d'établissement), mais aucun n'a permis de prédire de manière significative les opinions des enseignants et des enseignantes sur l'efficacité des stratégies d'apprentissage. Même si les opinions des professeurs et des professeures ne correspondaient pas aux données reconnues, leurs points de vue fournissent des informations sur les stratégies d'apprentissage perçues comme bénéfiques et celles que les étudiants et les étudiantes sont susceptibles d'utiliser. L'apprentissage est un processus complexe qui peut être influencé par de nombreux facteurs. Par conséquent, cet article rend compte des opinions des enseignants et des enseignantes canadiens concernant les stratégies d'apprentissage qui facilitent ce processus et présente des théories plausibles pour expliquer le décalage entre leurs points de vue et les meilleures preuves.

Keywords
learning strategies, study strategies, learning, studying; stratégies d'apprentissage, stratégies d'étude, apprentissage, étude

Cover Page Footnote
The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

This research paper/Rapport de recherche is available in The Canadian Journal for the Scholarship of Teaching and Learning: https://doi.org/10.5206/cjsotlrcacea.2025.1.18641

Students in academia have many decisions to make concerning their studies, decisions pertaining to a wide range of questions: What material should I study? In what order should I study the material? Should I study with a friend from class? Should I study in a group? Should I study alone? What time of day should I study? During the day? In the evening? How long should I study? When should I stop? So many questions, but the most critical inquiry might be what strategy to use in order to learn. What specific learning strategies are more effective than others?

The definition of a learning strategy varies. Chamot (2004) stated that learning strategies are mindful thoughts and actions that students use to achieve a goal. This goal requires metacognitive knowledge of their thinking strategies, the entailment of the goal, and their ability to accomplish it. Woolfolk et al. (2020) defined learning strategies as a pathway or unique series of actions taken toward learning. Various authors (e.g., Rachal et al., 2007; Van Hout-Wolters, 1992) have defined learning strategies as having a goal-oriented focus to improve learning. Pressley et al. (1989) defined learning strategies as "processes (or sequences of processes) that, when matched to the requirement of tasks, facilitate performance" (p. 303).

Much research has been conducted on learning strategy effectiveness in an attempt to determine which strategies are most effective. For example, practice testing and distributed practice have been proven across many academic papers to be effective learning strategies (Adesope et al., 2017; Butler, 2010; McCabe et al., 2016; Rowland, 2014), and testing has been demonstrated to have many benefits (Roediger et al., 2011). Various studies have also demonstrated that testing is superior for long-term retention as compared to consistently re-reading the study material (e.g., McDermott et al., 2014; Roediger & Butler, 2011; Rowland, 2014) and some studies have noted the limited benefits of re-reading textbooks (e.g., Callender & McDaniel, 2009). In addition, several studies (Hartley & Marshall, 1974; Kiewra, et al., 1987; Locke, 1977) have shown that students struggle to document lecture information; thus, learning via summarizing notes might create challenges for students.

One of the most cited academic articles on learning strategies was written by Dunlosky et al. (2013), who completed a comprehensive breakdown of 10 learning techniques. The authors examined past research on various learning strategies, including discussions of how and why a technique works, its strengths and limitations, and the strategy's performance in various areas. These areas included the type of material to be learned (e.g., math or social sciences), the learning condition (e.g., open or closed book exams), student characteristics (e.g., age, gender, motivation, confidence) and criterion tasks (e.g., cued versus free recall tests, essay writing). Dunlosky et al. (2013) then rated the effectiveness (low, moderate, or high) of various learning strategies. Several reasons were given for rating a strategy as low, including limited benefits, insufficient research to support the strategy, and weaker performance relative to other strategies. Those rated as moderate were generalized across some variables but had limited evidence of effectiveness. The high rating was reserved for studies that were generalized (the technique could be used across many environments) and improved student learning across many criterion tasks. Table 1 shows the breakdown of Dunlosky et al.'s (2013) rankings.

Table 1

Learning Strategy Assessment by Dunlosky et al. (2013)

Technique	Rank
Summarization	Low
Highlighting	Low
The keyword mnemonic	Low
Imagery	Low
Re-Reading	Low
Self-Explanation	Moderate
Elaborative interrogation	Moderate
Interleaved practice	Moderate
Practice testing	High
Distributed practice	High

The Dunlosky model is not without its limitations, as the author cited numerous limitations to the scope of their research, including insufficient evidence with respect to various generalizability categories (learners, materials, criterion tasks, issues for implementation, and educational contexts).

Knowing what learning strategies are effective might be helpful for many students, and paramount for some, but do students use empirically supported learning strategies? Karpicke (2009) surveyed 177 students and asked them about their study techniques. The author found persistent reading the most frequently listed (84%) and favoured (55%) technique. Tied in second place as the favourite strategy was re-writing notes and practicing problems (12.4%). All other strategies (flashcards, studying in groups, memorizing, mnemonics, outlines, highlighting, and thinking of real-life examples) were favoured by less than 10% of students. Concerning testing, only 11% (19 of 177 students) reported testing themselves while studying. More recent studies by Morehead et al. (2016) and Piza et al. (2019) asked students about their study strategy knowledge. While Morehead et al. (2016) reported mixed results concerning student knowledge of empirically supported learning strategies, Piza et al. (2019) found that "students endorsed many study habits which violate evidence-based principles" (p. 1411).

Knowing which learning strategies are empirically supported might also be important for faculty, but if they know the strategies that are effective, do they recommend them? In addition to enquiring into students' knowledge, Morehead et al. (2016) and Piza et al. (2019) raised this question as well and proceeded to survey faculty on whether learning strategies were discussed in class. In Morehead et al.'s (2016) study, 79% of teachers answered "yes," while only 52% stated "yes" in the study by Piza et al. (2019). Regarding the strategies recommended, faculty in both studies were given a list of strategies by the researchers and asked to select those that they endorsed. While the results were mixed, a considerable proportion of faculty in both studies advocated for non-evidenced-based learning strategies. McCabe (2018) examined whether the heads of academic support centres (N = 77) endorsed empirically supported learning strategies, and the results also presented "mixed evidence" (p. 143) of technique alignment with evidence-based literature.

Knowledge of learning strategies is essential for faculty and students as it can directly affect learning (Dinsmore & Hattan, 2020). Knowledge of learning strategies extends to not only

awareness of the various techniques but also distinguishing between empirically supported effective and non-effective strategies and the advantages/disadvantages of each approach.

Research Questions

This paper will add to the research on learning strategies by examining Canadian post-secondary faculty to explore (1) How do Canadian faculty rate the effectiveness of various learning strategies? (2) What factors contribute to the effectiveness ratings of these learning strategies?

Method

Seven Canadian academic institutions (three colleges and four universities located in the province of Ontario) were surveyed on their opinions of learning strategy effectiveness. The study received ethics approval from the Cambrian College Research Ethics Committee. A total of 7015 emails were sent to faculty from various institutions, with 544 completing the survey (response rate of 7.8%).

Participants

One of the initial goals of this research was to compare faculty opinions across the two types of post-secondary institutions in Canada (college and university); however, instructor characteristics other than institutional affiliation were also considered. Table 2 presents the characteristics of the faculty surveyed. Most faculty had a Ph.D. (45.2%), did not have a degree in education (77%), were full-time (68.1%), had 0–5 years of teaching experience (32.7%), and were from a university institution (58.3%). It is important to note that while most faculty (32.7%) reported having fewer than six years of teaching experience, years of experience were measured in increments of five years and every increment had values of over 10% and most over 15%: 11–15 years (20.2%), 6–10 years (18.6%), 20+ years (15.6%), and 16–20 years (12.9%).

The faculty participants were also asked if they recommend learning strategies to their students, and 89.5% answered “yes,” while 10.5% stated “no.” Concerning the timing of the recommendations and their use by students, most faculty reported giving learning strategy recommendations to their students “before an assessment” (40.6%) and believed that their students used the recommendations in all their classes (39.6%). Faculty were also asked if they believed students used their learning strategy recommendations, and most stated that students used the endorsements in all their classes (39.6%) or only in the faculty’s class (38%).

Table 2

Descriptive Statistics of Instructors Sampled

Variable	Percentage	Variable	Percentage
Level of Highest Degree		*Additional Teacher Training*	
Ph.D.	45.2%	Some training	7.6%
Master's Degree	35.4%	No training	92.4%
Bachelor's Degree	13.7%		
Trade School	5.7%		
Degree in Education		*Gender*	
Yes	23%	Male	53.2%
No	77%	Female	46.8%
Employment Status		*Recommendation of Learning Strategies*	
Part-Time	31.9%	Yes	89.5%
Full-Time	68.1%	No	10.5%
Number of Years Teaching		*Frequency of Learning Strategy Recommendation*	
0–5 years	32.7%	A few times a class	14.0%
6–10 years	18.6%	About once a class	36.6%
11–15 years	20.2%	Before assessment	40.6%
16–20 years	12.9%	Do not recommend	8.8%
20+ years	15.6%		
Institution Type		*Student Use of Faculty Recommended Strategies*	
College	41.7%	Yes – all classes	39.6%
University	58.3%	Yes – only my class	38.0%
		No	14.1%
Teaching Subject Area		Do not recommend	8.3%
Sciences	25.3%		
Social Sciences	33.0%		
Languages	7.9%		
Business	15.6%		
Computers	5.4%		
Creative Arts	7.9%		
Trades	4.9%		

Materials

The study instrument consisted of a questionnaire. The first section on learning strategies asked participants to rate 14 strategies, nine from Dunlosky et al. (2013) plus five others on a 5-point scale: very poor, poor, moderate, effective, and very effective. This research did not include the Dunlosky et al. (2013) strategy of self-exploration but added five additional techniques not included in their paper. The additional learning strategies were cramming the night before a test,

using flashcards, studying in a group, using diagrams, and asking questions in class. These were included as they are popular strategies, both in the literature and in the author's experience as an instructor.

Afterward, two scenario questions were adapted from Morehead et al. (2016), the first asking instructors why students should test themselves. The options included an empirically based answer ("they learn more this way than through re-reading") and two non-evidenced based answers ("it helps them figure out how well they learned the information"; "I do not think testing will benefit students"). The second scenario involved interleaving, where instructors were asked to rate the value of two strategies, one empirically supported (moving back and forth from chapter to chapter) and one non-empirically supported (block studying).

Results

Table 3 summarizes instructors' responses to the survey questions on the effectiveness of learning strategies. Instructors were asked to rate the effectiveness of various strategies as very poor (score of 1), poor (score of 2), moderate (score of 3), effective (score of 4), and very effective (score of 5). The mean rating for each strategy is reported, as is the percentage of respondents selecting each effectiveness rating. The learning strategies taken from Dunlosky et al. (2013) are presented in three categories based on their rankings in the Dunlosky et al. (2013) study (low, moderate, and high effectiveness), and the supplemental techniques (labelled 'other strategies'), which were added to this study, are listed underneath. Henceforth, any strategy or ranking that was used in the Dunlosky et al. (2013) study will be referred to as a 'Dunlosky' strategy/ranking.

As Table 3 demonstrates, the strategy of cramming had the lowest mean effectiveness score from faculty participants in this research (mean score 1.5). It was followed by interleaving (mean score 3.2). Nine strategies (interleaving, highlighting, mnemonics, flashcards, re-reading, imagery, studying with friends, distributed practice and practice testing) all had mean scores ranging from 3.2 to 3.9, indicating moderate effectiveness. The strategies with mean scores above 3.9 included diagrams (4.1), elaborate interrogation (4.2), and the highest-ranked strategy in this study: asking questions in class (4.4).

Concerning the difference between these two types of institutions, the Government of Ontario (2023) states, "Colleges offer certificate programs, diplomas, apprenticeships, and degrees. Universities offer undergraduate and graduate degrees and other professional programs" (para. 3).

Table 3

Instructor Views on Strategy Effectiveness

Strategy – Low Effectiveness (*)	Mean	SD	VP	PR	MOD	EFF	VE
Summarizing	4.09	.74	--	1.7%	18.2%	49.5%	30.6%
Highlighting	3.22	.99	5.1%	15.6%	39.5%	31.1%	8.6%
Mnemonics	3.30	1.0	5.2%	13.0%	39.5%	31.0%	11.3%
Imagery	3.68	.90	1.7%	7.2%	29.9%	43.7%	17.5%
Re-Reading	3.56	.59	1.3%	9.2%	35.1%	41.5%	12.9%
Ave. Low Strategies	3.58	.59					
Strategy – Moderate Effectiveness (*)							
Interleaving	3.20	.92	3.9%	14.4%	47.5%	26.4%	7.9%
Elaborative Interrogation	4.24	.76	0.6%	1.5%	11.6%	46.0%	40.4%
Ave. Moderate Strategies	3.73	.64					
Strategy – High Effectiveness (*)							
Practice Testing	3.92	.87	1.1%	3.3%	25.2%	43.4%	27.0%
Distributed Practice	3.73	.70	1.1%	4.6%	31.2%	46.0%	17.1%
Ave. High Strategies	3.82	.70					
Other Strategies (^)							
Cramming	1.52	.74	59.5%	31.1%	7.4%	1.7%	0.4%
Flashcards	3.33	1.0	5.1%	14.2%	33.8%	36.8%	10.1%
Diagrams	4.09	.82	0.6%	3.3%	15.9%	47.0%	33.3%
Studying w/ Friends	3.69	.90	0.9%	7.9%	31.7%	40.2%	19.5%
Asking Questions in Class	4.36	.69	--	0.2%	11.4%	41.1%	47.3%

Note. (*) = according to Dunlosky; (^) = strategies not classified by Dunlosky. Strategy effectiveness was measured on a 1–5 scale: 1 = very poor (VP), 2 = poor (PR), 3 = moderate (MOD), 4 = effective (EFF), 5 = very effective (VE). SD = standard deviation.

As reported in Table 4, despite this study having eight demographic independent variables and assessing 14 strategies, only 28 of 104 (26.9%) comparisons resulted in significant differences. Most importantly, all the significant associations had either low correlational strength or low effect size. Therefore, an overarching conclusion would be that faculty demographics selected in this research are not a strong factor in predicting the effectiveness ratings of learning strategies.

Table 4

Study Strategy Rating—Significant Group Differences for Various Strategies

Strategy	# of Significant Differences	Range of Effect Sizes (*r* or eta squared)	Faculty Demographic Associations
Summarizing	2/8	*r*: -.01; eta = .01	Level of Education, Institution
Highlighting	3/8	*r*: -.01; eta = .01	Level of Education, Employment Status, Institution
Mnemonics	2/8	eta = .01 and .04	Degree in Education, Gender
Imagery	4/8	eta: .01 to .04	Degree in Education, Institution, Subject, Gender
Re-Reading	0/8		
Interleaving	3/8	*r*: -.13; eta: .01 to .03	Level of Education, Institution, Subject
Elaborate Int.	2/8	eta = .03 and .02	Subject, Gender
Practice Testing	3/8	*r*: -.03; eta: .01 to .04	Level of Education, Institution, Gender
Distributed Practice	1/8	eta = .02	Gender
Cramming	2/8	*r*: -.10; eta = .01	Level of Education, Institution,
Flashcards	4/8	*r:* -.10 and -.13 eta: .02 to .03	Level of Education, Years of Teaching Experience, Institution, Gender
Studying w/ Friends	2/8	*r*: .10; eta = .02	Years of Teaching Experience, Gender
Asking Questions	0/8		

Faculty Opinions on Why Students Should Test Themselves

A scenario question adapted from Morehead et al. (2016) asked faculty to choose the best answer for why students should test themselves. Three possible answers were given, including two that were non-empirically supported: (1) “it helps them to figure out how well they learned the information,” and (2) “I do not think testing will benefit students.” The empirically supported answer was (3) “they learn more this way than through re-reading.” When asked why students should test themselves, 80.3% of instructors in this study chose the non-empirically supported answers (see Table 5).

Table 5

Scenario Question #1: Why Should Students Test Themselves?

Answer	Percentage
They learn more this way than through re-reading	19.7%
It helps them to figure out how well they learned the information	70.0%
I do not think testing will benefit students	10.3%

A Pearson product-moment correlation coefficient analysis showed that the only significant relationship with opinion on why students should test themselves was level of education (r = -.092, n = 539, p = .032). Instructors with higher education were more likely to choose the empirically supported answer ("they learn more this way than through re-reading").

Different Opinions on Interleaved Practice

The second scenario, also adapted from Morehead et al. (2016), asked instructors to rate the value of two strategies, one involving interleaving. This is a study strategy where the teacher or student moves around in the textbook, switching from one topic to another and combining concepts. Thus, instead of going through the text in chronological order, beginning with chapter one and then chapter two (called 'blocking'), the teacher or student moves back and forth through various chapters. Empirical evidence (Dunlosky et al., 2013) has proven interleaving superior to blocking for long-term memory.

To find out which method instructors thought was more effective, this study presented them with a scenario, also adapted from Morehead et al. (2016), where two students had three chapters to learn. Using the non-empirically supported strategy, Student A used the blocking technique, studying one chapter at a time. Using the empirically supported strategy of interleaving, Student B moved around from chapter to chapter, studying a little at a time from each chapter. Instructors were asked to evaluate the benefits of each strategy by choosing one of three responses: (1) not at all beneficial, (2) somewhat beneficial, and (3) very beneficial.

Table 6 contains the faculty's answers to the second scenario question. Only 9.1% of the instructors provided a higher rating for Strategy B (empirically supported strategy) than Strategy A (non-empirically supported strategy).

Table 6

Scenario Question #2: How Would You Evaluate the Benefits of Blocking and Interleaving?

Strategy	Not Beneficial	Somewhat Beneficial	Very Beneficial
Blocking (A)	0.2%	40.3%	59.5%
Interleaving (B)	14.2%	68.6%	17.2%

Faculty participant answers to the interleaving scenario question were compared across the demographic variables in the research, and two significant relationships were noted: the number of years the faculty had taught and the gender of the instructor. For the following analyses, the answers were coded numerically: not beneficial (1), somewhat beneficial (2), and very beneficial (3). Using a Pearson product-moment correlation coefficient analysis, it was found that years of teaching were significantly correlated with the interleaving scenario (r = .61, n = 541, p < .001), indicating that instructors with greater teaching experience were more likely to rank Strategy B (empirically supported strategy) as more beneficial. An independent-samples t-test yielded that gender was significantly related to the interleaving scenario (t = 2.78, p = .006, eta squared = .01). Female faculty (M = 2.1, SD = .55) were more likely to support the use of interleaving (Strategy B) than male faculty (M = 1.9, SD = .56); however, both gender averages were at or close to the 'somewhat beneficial' rating with respect to this strategy.

Discussion

This research aimed to explore faculty opinions on learning strategies by asking instructors to rate the effectiveness of 14 techniques and provide their opinions on two scenarios involving specific strategies: testing (why students would practice test themselves) and interleaved practice. One of the main goals of this project was to examine the different views of Canadian college and university faculty concerning study strategy effectiveness while investigating a total of eight demographic independent variables. The results indicated mixed findings for faulty identification of effective learning strategies against best evidence and that faculty characteristics were not meaningful predictors of their opinions. The results of this study are concerning; if faculty knowledge of empirically supported learning strategies is mixed, they might not be applying them in their classrooms or teaching students how to learn more effectively.

One of the most interesting findings in this study was the lack of low-effectiveness study strategy ratings by the faculty participants. Outside of cramming the night before the assessment, none of the strategies in this research were rated in the very poor or poor category, in contrast to previous academic research on learning strategies (Dunlosky et al., 2013). In Dunlosky et al. (2013), five strategies were ranked as ineffective, including summarizing notes, highlighting, mnemonics, imagery, and re-reading the textbook/course materials. In this research, only two Dunlosky strategies (summarizing notes and elaborative interrogation) were rated as more than moderately effective and eight of the 14 strategies (57%) were rated as moderately effective, indicating that the faculty participants in this study did not view many of the strategies as either very effective or ineffective.

The faculty participants rated two of the four non-Dunlosky strategies as moderately effective (flashcards, studying with friends) and two as very effective (diagrams and asking questions in class). However, all four of these strategies have recognized limitations and limited evidence of effectiveness. For example, diagrams have generalizability challenges (Acevedo et al., 2009), which the Dunlosky model reports as a barrier to high effectiveness. Concerning the strategy of asking questions in class, research has not only shown that students rarely ask questions in class (Dillon, 1988; Graesser & Person, 1994; Pearson & West, 1991) but that the grading advantage for students who do ask questions is uncertain (Handelsman et al., 2005; O'Connor et al., 2017). Studying with friends also has many challenges (see Basden et al., 1997; Clark et al., 2000; Finlay et al., 2000). Group studying may demand training, a requirement that makes it unsuitable as an effective strategy for most students, according to the Dunlosky model. Finally, regarding flashcards, it is interesting to note that, by definition, this strategy is a type of practice test, but it was rated lower (M = 3.3) than practice testing (M = 3.9). This lower rating could be due to faculty believing that flashcards are only effective in preparing for simple assessments or enhancing surface-level learning as compared to other forms of practice testing, which promote deeper-level learning.

This research used two scenarios adapted from Morehead et al. (2016) to enquire into faculty's views on the effectiveness of practice testing and interleaving. In the first scenario, faculty were asked why students should test themselves and only 19.7% of the participants identified the empirically supported answer that students would learn more through this method than through re-reading. The findings in this research are almost identical to those in Morehead et al. (2016), where only 19% gave the empirically supported answer, although they diverge somewhat from Piza et al. (2019), where 36% of faculty provided the empirically supported answer. Of further interest is the fact that only one of the independent variables (level of faculty education) was significantly related

to providing the empirically supported answer, with instructors who had higher education being more likely to affirm that students would learn more through self-testing than through re-reading. Therefore, in accordance with the findings of Morehead et al. (2016) and Piza et al. (2019), this study concludes that even though faculty might endorse practice testing (i.e., as a way of assessing knowledge), they do not recognize the advantages of self-testing with respect to increased learning.

In the second scenario, focused on interleaving, faculty participants stated their opinions on the strategy's benefits by rating them as higher or lower than those of block studying. The empirically supported answer would require faculty to rate interleaving as more beneficial than the blocking technique. Only 9.1% of the faculty participants rated the interleaving scenario as more beneficial, which throws into question their awareness of the strategy's benefits. However, the results of this experiment correlate with those of Morehead et al. (2016), where only 16% of students and 13% of teachers provided a higher rating for the empirically supported scenario. Piza et al. (2019) also used the interleaving scenario in their research, with 37% of students and 39% of faculty providing higher ratings for this strategy. A study by Grospietsch and Mayer (2019) asked pre-service biology teachers if blocked learning is more effective than interleaving, and 52% agreed. The above findings support those of the current study, which indicate that instructors underestimate the advantages of interleaving as a learning strategy.

To this researcher's knowledge, no studies have been conducted to explain the lack of faculty knowledge surrounding the benefits of interleaving. Only cramming the night before a test got a lower mean effectiveness rating score in this study than interleaved practice. Interleaving can be confusing as it is a complex technique in comparison to highlighting or re-reading a textbook, and many students are unfamiliar with it. Even summarizing notes, which takes some skill, is a more well-known strategy. Interleaving, however, is a more flexible strategy as it can be used with a large variety of other learning strategies. This flexibility may help to explain its effectiveness, although the strength of the strategies used with interleaving will evidently also have an impact. For example, by combining interleaving with re-reading, a low-effective strategy according to the Dunlosky model, a student might re-read 10 pages from chapter one, then the first 10 pages of chapter two, and proceed to move back and forth between the chapters. If a student used interleaving with re-reading, the learning might not be as effective as moving back and forth between concepts in different chapters, practice testing conceptual knowledge. Considerable research has been conducted on interleaving, and the evidence indicates it supports learning. Therefore, additional research is needed to explore why faculty do not recommend it.

Theories on the Lack of Faculty Alignment with Empirical Research

While several studies (McCabe, 2018; Morehead et al., 2016; Piza et al., 2019) have examined faculty perceptions of learning strategies, to the knowledge of this researcher, there are no papers that investigate the reasons why instructors do not recognize the value of empirically-based learning strategies or recommend them to their students. It is reasonable to consider that faculty focus might be on the content of the course rather than on learning strategies, thus decreasing the time instructing students on how to learn. Post-secondary teachers may believe their students already have learning strategies that work for them and hence, may not see the benefits of researching empirically supported learning strategies and teaching them in their classes. It is also possible that teachers have a large, diversified workload and do not have the time to research strategies that are effective or devote attention to teaching students how to use empirically supported learning strategies. However, if faculty and students are recommending and using

learning strategies that are not empirically supported, as this study and others have found (McCabe, 2018; Morehead et al., 2016; Piza et al., 2019), their lack of knowledge is a cause for concern as these findings imply a cycle of misinformation that will continue to next generations of teachers and students.

Limitations

While this study had 544 responses, 7,015 emails were sent to faculty from various institutions, indicating a response rate of 7.8%. This low rate of response indicates that the sample might not be fully representative of the Canadian post-secondary educational system. As with most surveys, those faculty that responded may have been more interested in the topic or more knowledgeable than others, biasing the results. The results of this study also do not reflect which learning strategies the faculty participants use in their classrooms. The survey only asked faculty to rank various learning strategies, so participants may not have experience with all the techniques.

Learning is a complex phenomenon, and the learning strategies that work for some students may not work for others. Moreover, teachers have a demanding job as students come into the classroom with various experiences that influence how they learn the course material. Their socio-economic backgrounds, for example, could affect the resources required to learn. In addition, students have various prior knowledge levels, ranging from significant to insignificant, that affect their learning, and every institution, program, and course, is characterized by factors that could affect student learning (e.g., the college/university environment, the communication skills of the instructor, the difficulties of the course, or the number of assignments given). Some students are highly motivated and give maximum effort, while others are satisfied to get by with minimal effort, and this difference will also impact the effectiveness of a study strategy. A student who is motivated to use a particular strategy, puts in the effort, and uses metacognition to reflect and evaluate whether the technique works for them will likely have greater success in learning. In sum, numerous factors pertaining to the individual student, the course, the teacher, and the institution, can impact study strategy effectiveness, thus limiting the universal strength of any model of learning techniques.

Conclusions and Recommendations for Academia

Canadian university and college faculty were surveyed on their opinions of learning strategy effectiveness. The results were mixed concerning best evidence, and faculty characteristics were not strong predictors of learning strategy effectiveness ratings or ability to identify empirically supported strategies (i.e., practice testing and interleaving). This study offers an opportunity for faculty to reexamine their teaching practices and the curriculum in teaching education and professional development. The insight gained from this research can open doors for professional collaborations to foster metacognitive awareness. For example, faculty can reexamine their curriculum and place a stronger emphasis on teaching students how to learn, which could also enhance the student's metacognitive awareness. Teachers could encourage practice testing as often as possible and demonstrate to the students the advantages of the strategy for increased learning. Emphasis must be placed on awareness of the various learning strategies and providing context as to why the techniques have advantages and limitations. Faculty must acquire knowledge of empirically supported learning strategies. Faculty have a responsibility to disseminate not only

the content of the course but also effective methods to learn the material, not only for short-term assessment results but also for long-term learning.

References

Acevedo Nistal, A., Clarebout, G., Elen, J., Van Dooren, W., & Verschaffel, L. (2009). Conceptualising, investigating and stimulating representational flexibility in mathematical problem solving and learning: A critical review. *ZDM-The International Journal on Mathematics Education, 41*, 627–636. https://doi.org/10.1007/s11858-009-0189-1

Adesope, O. O., Trevisan, D. A., & Sundararajan, N. (2017). Rethinking the use of tests: A meta-analysis of practice testing. *Review of Educational Research, 87*(3), 659–701. https://doi.org/10.3102/0034654316689306

Basden, B. H., Basden, D. R., Bryner, S., & Thomas III, R. L. (1997). A comparison of group and individual remembering: Does collaboration disrupt retrieval strategies? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23*(5), 1176–1189. https://doi.org/10.1037/0278-7393.23.5.1176

Butler, A. C. (2010). Repeated testing produces superior transfer of learning relative to repeated studying. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 36*(5), 1118–1133. https://doi.org/10.1037/a0019902

Callender, A. A., & McDaniel, M. A. (2009). The limited benefits of rereading educational texts. *Contemporary Educational Psychology, 34*(1), 30–41. https://doi.org/10.1016/j.cedpsych.2008.07.001

Chamot, A. U. (2004). Issues in language learning strategy research and teaching. *Electronic Journal of Foreign Language Teaching, 1*(1), 14–26.

Clark, S. E., Hori, A., Putnam, A., & Martin, T. P. (2000). Group collaboration in recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*(6), 15781588. https://doi.org/10.1037//0278-7393.26.6.1578

Dillon, J. T. (1988). The remedial status of student questioning. *Journal of Curriculum Studies, 20*, 197–210. https://doi.org/10.1080/0022027880200301

Dinsmore, D. L., & Hattan, C. (2020). Levels of strategies and strategic processing. In D. L. Dinsmore, L. K. Fryer, & M.M. Parkinson (Eds.), *Handbook of strategies and strategic processing* (pp. 29-46). Routledge. https://doi.org/10.4324/9780429423635-3

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4–58. https://doi.org/10.1177/1529100612453266

Finlay, F., Hitch, G. J., & Meudell, P. R. (2000). Mutual inhibition in collaborative recall: Evidence for a retrieval-based account. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*(6), 1556–1567.

Government of Ontario. (2023, March 2). *Go to college or university in Ontario*. https://www.ontario.ca/page/go-college-or-university-ontario

Graesser, A. J., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal, 31*, 104–137. https://doi.org/10.2307/1163269

Grospietsch, F., & Mayer, J. (2019). Pre-service science teachers' neuroscience literacy: Neuromyths and a professional understanding of learning and memory. *Frontiers in Human Neuroscience, 13*, Article 20. https://doi.org/10.3389/fnhum.2019.00020

Handelsman, M. M., Briggs, W. L., Sullivan, N., & Towler, A. (2005). A measure of college student course engagement. *The Journal of Educational Research, 98*, 184–191. https://doi.org/10.3200/JOER.98.3.184-192

Hartley, J., & Marshall, S. (1974). On notes and note-taking. *Higher Education Quarterly*, *28*(2), 225–235. https://doi.org/10.1111/j.1468-2273.1974.tb00467.x

Karpicke, J. D. (2009). Metacognitive control and strategy selection: Deciding to practice retrieval during learning. *Journal of Experimental Psychology: General*, *138*(4), 469. https://doi.org/10.1037/a0017341

Kiewra, K. A., Benton, S. L., & Lewis, L. B. (1987). Qualitative aspects of notetaking and their relationship with information-processing ability and academic achievement. *Journal of Instructional Psychology*, *14*(3), 110.

Locke, E. A. (1977). An empirical study of lecture note taking among college students. *The Journal of Educational Research*, *71*(2), 93–99. https://doi.org/10.1080/00220671.1977.10885044

McCabe, J. A. (2018). What learning strategies do academic support centers recommend to undergraduates? *Journal of Applied Research in Memory and Cognition*, *7*(1), 143–153. https://doi.org/10.1016/j.jarmac.2017.10.002

McCabe, J. A., Redick, T. S., & Engle, R. W. (2016). Brain-training pessimism, but applied-memory optimism. *Psychological Science in the Public Interest*, *17*(3), 187–191. https://doi.org/10.1177/1529100616664716

McDermott, K. B., Agarwal, P. K., D'Antonio, L., Roediger, H. L., III, & McDaniel, M. A. (2014). Both multiple-choice and short-answer quizzes enhance later exam performance in middle and high school classes. *Journal of Experimental Psychology: Applied*, *20*(1), 3–21. https://doi.org/10.1037/xap0000004

Morehead, K., Rhodes, M. G., & DeLozier, S. (2016). Instructor and student knowledge of study strategies. *Memory*, *24*(2), 257–271. https://doi.org/10.1080/09658211.2014.1001992

O'Connor, C., Michaels, S., Chapin, S., & Harbaugh, A. G. (2017). The silent and the vocal: Participation and learning in whole-class discussion. *Learning and Instruction*, *48*, 5–13. https://doi.org/10.1016/j.learninstruc.2016.11.003

Pearson, J. C., & West, R. (1991). An initial investigation of the effects of gender on student questions in the classroom: Developing a descriptive base. *Communication Education*, *40*, 23–32. https://doi.org/10.1080/03634529109378823

Piza, F., Kesselheim, J. C., Perzhinsky, J., Drowos, J., Gillis, R., Moscovici, K., Danciu, T. E., Kosowska, A., & Gooding, H. (2019). Awareness and usage of evidence-based learning strategies among health professions students and faculty. *Medical Teacher*, *41*(12), 1411–1418. https://doi.org/10.1080/0142159X.2019.1645950

Pressley, M., Goodchild, F., Fleet, J., Zajchowski, R., & Evans, E. D. (1989). The challenges of classroom strategy instruction. *The Elementary School Journal*, *89*(3), 301–342. https://doi.org/10.1086/461578

Rachal, K. C., Daigle, S., & Rachal, W. S. (2007). Learning problems reported by college students: Are they using learning strategies? *Journal of Instructional Psychology*, *34*(4), 191–200. https://doi.org/10.1037/e516532007-001

Roediger, H. L., III & Butler, A. C. (2011). The critical role of retrieval practice in long-term retention. *Trends in Cognitive Sciences*, *15*(1), 20–27. https://doi.org/10.1016/j.tics.2010.09.003

Roediger, H. L., III, Putnam, A. L., & Smith, M. A. (2011). Ten benefits of testing and their applications to educational practice. In J. Mestre & B. Ross (Eds.), *Psychology of learning and motivation: Cognition in education* (pp. 1–36). Elsevier. https://doi.org/10.1016/B978-0-12-387691-1.00001-6

Rowland, C. A. (2014). The effect of testing versus restudy on retention: A meta-analytic review of the testing effect. *Psychological Bulletin, 140*(6), 1432–1463. https://doi.org/10.1037/a0037559

Van Hout-Wolters, B. H. A. M. (1992). *Cognitieve strategieën als onderwijsdoel. [Cognitive strategies as educational goal*]. Wolters-Noordhoff.

Woolfolk, A., Winne, P. H., & Perry, N. E. (2020). *Educational psychology* (7th ed.). Pearson Education Canada.