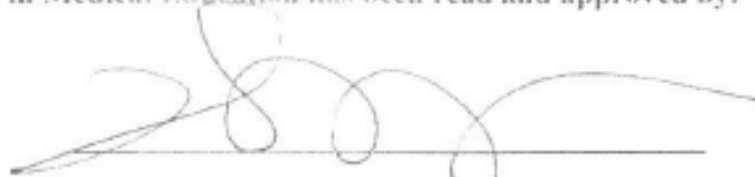



This Thesis, *Assessing awareness and use of evidence-based learning strategies among health professions students and faculty*, presented by Felipe Piza and Submitted to the Faculty of The Harvard Medical School in Partial Fulfillment of the Requirements for the Master of Medical Sciences in Medical Education has been read and approved by:



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**Assessing awareness and use of evidence-based learning strategies among health  
professions students and faculty**

Felipe Piza

A Thesis Submitted to the Faculty of

The Harvard Medical School

in Partial Fulfillment of the Requirements

for the Degree of Master of Medical Sciences in Medical Education

Harvard University

Boston, Massachusetts.

May, 2018

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**Assessing awareness and use of evidence-based learning strategies among health professions students and faculty**

Abstract

**Introduction:** Learning is essential and life-long for faculty and students. Often students and teachers use ineffective learning strategies and are not aware of which ones have the strongest evidence-base.

**Methods:** A multicenter, international, cross-sectional, online survey-based study assessing awareness and adoption of evidence-based learning strategies among health professions students (n=679) and faculty (n=205) from a total of 6 schools.

**Results:** Participants generally reported using few evidence-based study techniques. Over half of students surveyed 389/679 (57%) stated that they decide to study next whatever is due soonest, while about a quarter of the students 173/679 (26%) plan their study schedule. The majority of students 465/679 (68%) do not return to course material for review once the course has ended. Many students 298/679 (44%) re-read sections they have underlined or highlighted. Most students 558/679 (82%) reported that they do not study the way they do because a teacher taught them to do this way; however, many faculty members 125/157 (80%) claimed they recommend effective study strategies for their students. The majority of faculty 142/156 (91%) believe that students have different learning styles and 112/141 (79%) reported they teach to accommodate those differences. In the multiple regression analyses, students who reported following faculty

guidance on study habits had lower USMLE step 1 scores ( $\beta_1 = -13.21, p: 0.03$ ). Cramming before tests ( $\beta = -11.67, p: 0.02$ ) and studying with friends ( $\beta = -12.32, p: 0.02$ ) were also associated with lower Step 1 scores, when controlling for other variables ( $R^2 = 0.41$ ).

***Discussion:*** The results of this study demonstrate some awareness with remaining misconceptions among health professions students and faculty regarding evidence-based learning strategies. While planning a curriculum, medical educators should focus on teaching students how to learn and use higher order thinking procedures in addition to content. Medical schools can foster the development of medical expertise by enabling their faculty and students to develop these metacognitive capabilities.

## Table of Contents

1. Introduction .....	1
2. Methods .....	3
2.1. Study design .....	3
2.2. Ethical approvals .....	3
2.3. Instrument .....	3
2.4. Study population .....	4
2.5. Statistical analysis .....	5
3. Results .....	6
3.1. Student and Faculty Awareness of Evidence Based Study Techniques.....	8
3.2. Student and Faculty Ratings of Evidence and Non-Evidence Based Case Scenarios .....	15
3.3. Relationship between awareness of evidence-based study habits and test performance .....	17
4. Discussion .....	19
4.1. Potential and practical impact .....	21
4.2. Limitations .....	22
5. Conclusion .....	22
6. Bibliography .....	23-26
Appendices .....	27-45

## Figures

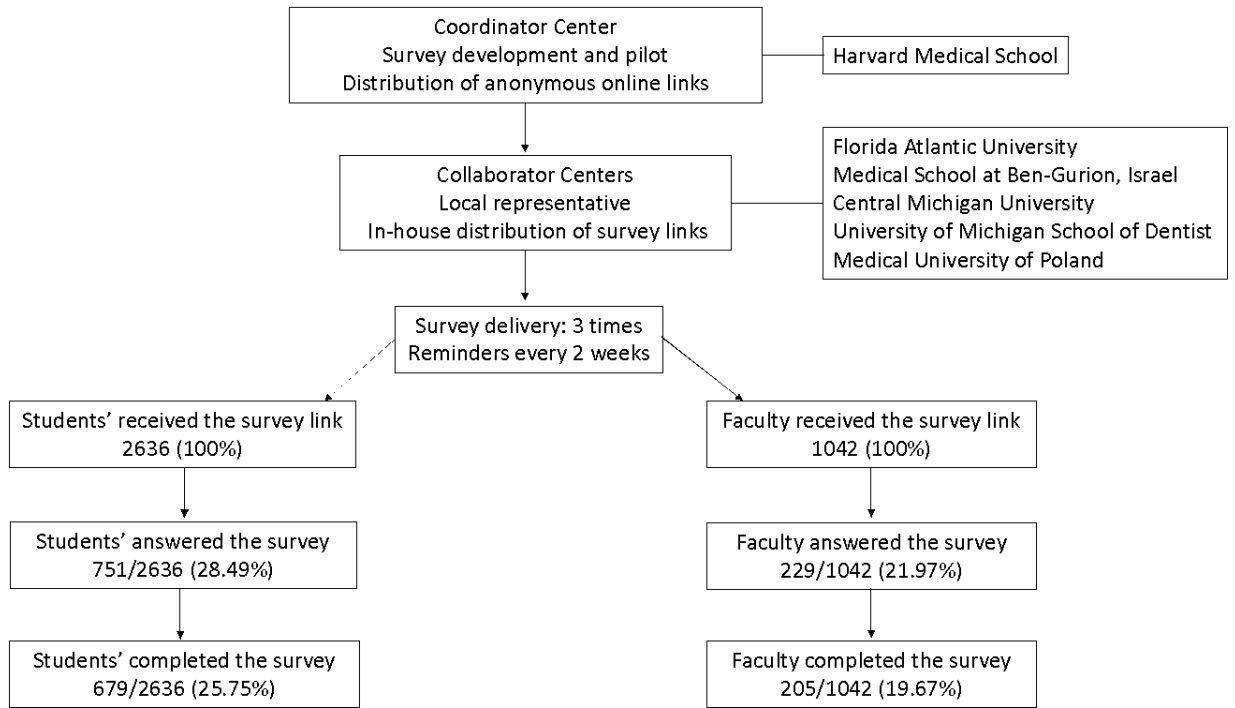


Figure 1- Study flow chart and participants' survey response rate

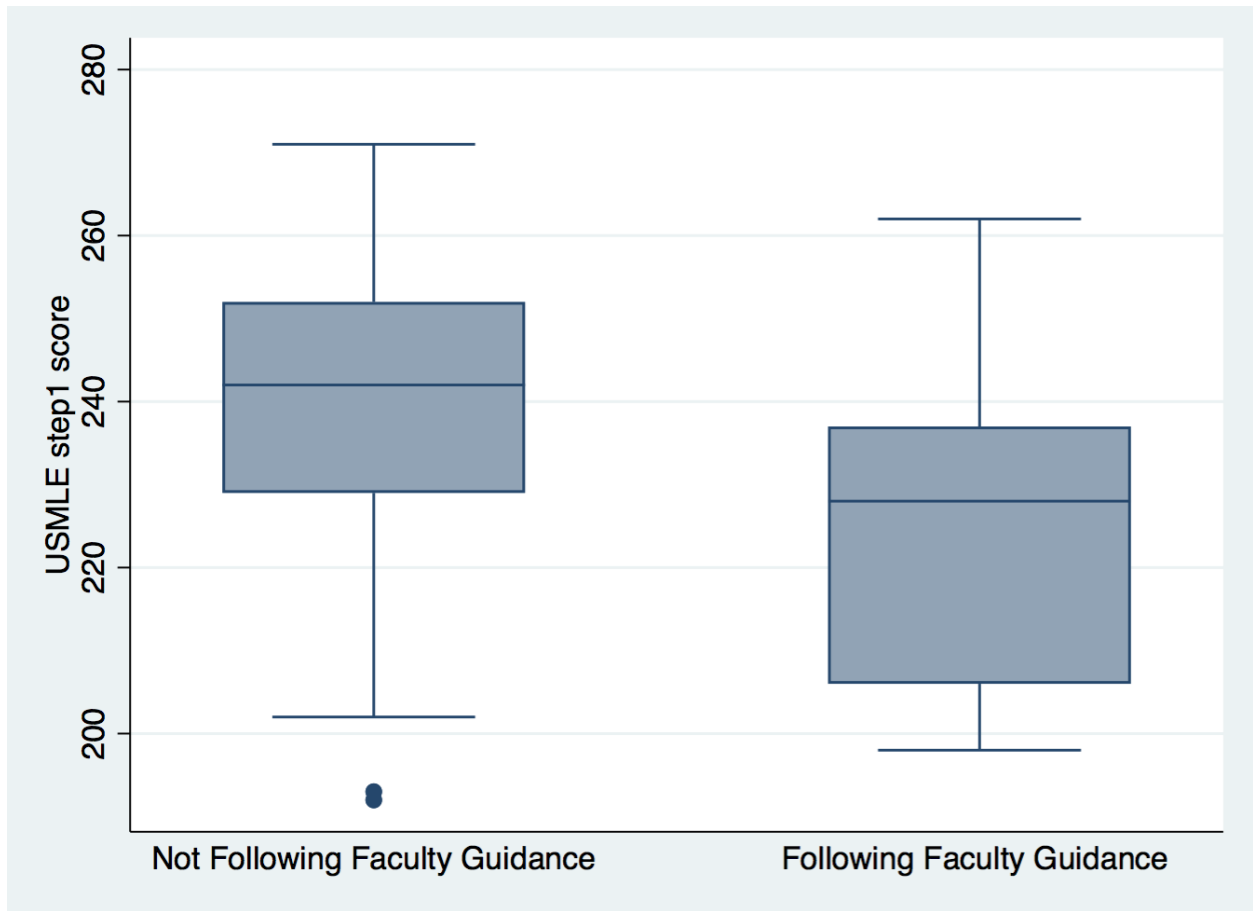


Figure 2. Box plot for student's self-reported USMLE step 1 scores based on following faculty guidance on how to study.

Note: Following faculty guidance how to study: Would you say that you study the way you do because a teacher (teachers) taught you to study that way?



## Tables

Table 1. Characteristics of Student and Faculty participants in a survey of awareness of effective learning strategies in health professions school

<b>Students' Variables</b>		<b>Faculty Variables</b>	
<i>School</i>	<i>N (%)</i>		<i>N / %</i>
Harvard Medical School	240 (35%)	Harvard Medical School	15 (7%)
Florida Atlantic University	74 (11%)	Florida Atlantic University	47 (23%)
Ben Gurion University, Israel	97 (14%)	Medical School at Ben Gurion	25 (12%)
University of Michigan School	176 (26%)	University of Michigan School	46 (22%)
Central Michigan University	80 (12%)	Central Michigan University	53 (26%)
Medical University of Poland	12 (2%)	Medical University of Poland	19 (10%)
<i>N total</i>	679 (100%)	<i>N total</i>	205 (100%)
<i>Gender</i>			
Men	349 (58%)	Men	74 (52%)
Women	244 (41%)	Women	63 (44%)
Other	1 (0.2%)	Other	1 (0.5%)
Prefer not to answer	5 (0.8%)	Prefer not to answer	5 (3.5%)
<i>N total</i>	599 (100%)	<i>N total</i>	143 (100%)
<i>Year of medical school</i>		<i>Teaching area</i>	
1 <sup>st</sup>	116 (27%)	Pre-clinical students	60 (42%)
2 <sup>nd</sup>	117 (27%)	Clinical students	45 (31%)
3 <sup>rd</sup>	106 (25%)	Residency	38 (27%)
4 <sup>th</sup>	75 (17%)	<i>N total</i>	143 (100%)
Over 4 <sup>th</sup>	19 (4%)		
<i>N total</i>	433 (100%)		
<i>Specialty desired</i>		<i>Academic rank</i>	
Internal Medicine	217 (36%)	Professor	27 (19%)
Pediatrics	32 (5%)	Associate Professor	38 (27%)
OBGYN	17 (3%)	Assistant Professor	51 (36%)
General Surgery	39 (7%)	Adjunct professor	6 (4%)
Neurology	16 (3%)	Graduate Assistant	9 (6%)
Psychiatry	14 (2%)	Instructor	7 (5%)
Family Medicine	13 (2%)	Academic Adviser	2 (1%)
Other	86 (14%)	Other	3 (2%)
Not decided	164 (28%)	<i>N total</i>	143 (100%)
<i>N total</i>	598 (100%)		
<i>Continuous Variables</i>	<i>Mean / SD</i>		<i>Mean / SD</i>
Age	25.60 / 3.93	Teaching Years	15.33 / 10.43
USMLE – step1	235 / 20.94	Percentage teaching time	36.58 / 26.55

Note: *N*: Number, %: percentage, SD: standard deviation, OBGYN: Obstetrics and Gynecology  
*N* varies along the survey due to variable participant response to each question.

Table 2. Students' responses to a survey of awareness of effective learning strategies

Questions	Choices	<i>N</i> / <i>N</i> total (%)
<b>Would you say that you study the way you do because a teacher (teachers) taught you to study that way?</b>	Yes	121/679 (18%)
	No	558/679 (82%)
<b>How do you decide what to study next?</b>	Whatever's due soonest/overdue	389/679 (57%)
	Whatever I haven't studied for the longest time	28/679 (4%)
	Whatever I find interesting	28/679 (4%)
	Whatever I feel I'm doing the worst in	61/679 (9%)
	I plan my study schedule ahead of time and I study whatever I've scheduled	173/679 (26%)
<b>Do you usually return to course material to review it after a course has ended?</b>	Yes	214/679 (32%)
	No	465/679 (68%)
<b>When you study do you typically read a text book/article/other source material more than once?</b>	Yes, I reread whole chapters/articles	98/679 (14%)
	Yes, I reread sections that I underlined/highlighted/marked	298/679 (44%)
	Not usually	283/679 (42%)

---

<b>If you quiz yourself while you study (either using a quiz at the end of a chapter or a practice quiz or flashcards or something else) why do you do so?</b>	I learn more that way than I would through rereading	229/669 (34%)
	To figure out how well I have learned the information I'm studying	268/669 (40%)
	I find quizzing more enjoyable than reading	53/669 (8%)
	I usually do not quiz myself	119/669 (18%)

---

---

<b>Imagine that in the course of studying you become convinced that you know the answer to a certain question (e.g., the definition of a medical term). What would you do?</b>	Make sure to study (or test yourself on) it again later	195/669 (29%)
	Put it aside and focus on other material	474/669 (71%)
<b>Which of the following best describes your pattern of study?</b>	I most often space out my study sessions over multiple days/weeks	471/669 (70%)
	I most often do my studying in one session before the test	198/669 (30%)
<b>Which of the following study strategies do you use regularly? (Please check off all that apply.)</b>	test yourself with questions or practice problems	485/661 (73%)
	use flashcards	217/660 (33%)
	recopy your notes	219/661 (33%)
	reread chapters, articles, notes, etc.	317/661 (48%)
	make outlines while reading	323/661 (49%)
	underline or highlight while reading	386/661 (58%)
	study with friends	308/661 (47%)
	“cram” lots of information the night before the test	263/661 (40%)
	ask questions or verbally participate during class	281/661 (43%)
	other (Please describe)	231/660 (35%)
		20/661 (3%)

---

<b>Do you believe you have a specific learning style (e.g., are you visual or verbal learner)?</b>	Yes	347/661 (53%)
	No	53/661 (8%)
	No, I learn best through multiple methods	261/661 (39%)

*N* varies along the survey due to variable participant response to each question.

Table 3. Faculty responses to a survey of awareness of effective learning strategies

<b>Questions</b>	<b>Choices</b>	<b>Response</b>
<b>Do you discuss study techniques in class?</b>	Yes	106/205 (52%)
	No	99/205 (48%)
<b>How often do you discuss study techniques?</b>	A few times a week	7/88 (8%)
	About once a week	25/88 (28%)
	Before tests/major assignments	26/88 (30%)
	About once every semester	22/88 (25%)
	Other	8/88 (9%)
<b>How do you think your students <i>choose</i> to study?</b>	Whatever's due soonest/overdue	108/158 (68%)
	Whatever they haven't studied for the longest time	3/158 (2%)
	Whatever they find interesting	16/158 (10%)
	Whatever they feel they're doing the worst in	14/158 (9%)
	They plan their study schedule ahead of time and they study whatever they have scheduled	17/158 (11%)
<b>How do you think your students <i>should</i> choose to study?</b>	Whatever's due soonest/overdue	7/158 (4%)
	Whatever they haven't studied for the longest time	0/158 (0%)
	Whatever they find interesting	15/158 (10%)
	Whatever they feel they're doing the worst in	25/158 (16%)
	They plan their study schedule ahead of time and they study whatever they have scheduled	111/158 (70%)
<b>Do you return to earlier material in later sections? (e.g., reviewing week 1 material near</b>	Yes	120/157 (76%)
	No	37/157 (24%)

<b>the middle of the semester)</b>			
<b>Do you recommend study techniques to students, either in class or during out of class meetings?</b>	Yes	125/157	(80%)
	No	32/157	(20%)
<b>if yes, which of the following study techniques do you recommend students use regularly? (please check off all that apply)</b>	test yourself with questions or practice problems	100/147	(68%)
	use flashcards	37/147	(25%)
	recopy your notes	11/147	(8%)
	reread chapters, articles, notes, etc.	46/147	(31%)
	make outlines while reading	54/147	(37%)
	underline or highlight while reading	45/147	(31%)
	make diagrams, charts, or pictures	64/147	(44%)
	study with friends	67/147	(46%)
	“cram” lots of information the night before the test	3/147	(2%)
	ask questions or verbally participate during class	100/147	(68%)
other (Please describe)	25/147	(17%)	
<b>If you do discuss study techniques in class, do you think students use those techniques?</b>	Yes	22/146	(15%)
	Yes for my class, but not necessarily for others	10/146	(7%)
	No	8/146	(5%)
	Some do, some do not	106/146	(73%)
<b>If you think students should quiz themselves (either using a quiz at the end of a chapter, a practice quiz, flashcards or something</b>	They will learn more that way than through rereading	56/155	(36%)
	To figure out how well they have learned the information they’re studying	82/155	(53%)
	I do not think quizzing will necessarily benefit	17/155	(11%)

<b>else), why should they do so?</b>			
<b>Do you use/encourage spacing techniques in class? (e.g., leaving days/weeks for students to study for the next exam or returning to information after discussing it)</b>	Yes		84/156 (54%)
	No		72/156 (46%)
<b>Do you believe students have different learning styles (e.g., visual vs. auditory learners)?</b>	Yes		142/156 (91%)
	No		14/156 (9%)
<b>Do you teach to accommodate those differences?</b>	Yes		112/141 (79%)
	No		29/141 (21%)

*N* varies along the survey due to variable participant response to each question.

Table 4. Participants' mean ratings and standard deviations for evidence-based (EB) and non-evidence based (Non-EB) options for the learning scenario questions.

Faculty Responses						
Scenario	<u>EB option</u>		<u>Non-EB option</u>		<u>Comparison</u>	
	M	SD	M	SD	t	Cohen's d
<b>Generation</b>	5.87	1.19	5.2	0.94	6.99**	0.62
<b>Retrieval</b>	4.81	1.45	4.18	1.39	3.64**	0.43
<b>Interleaving</b>	3.82	1.63	4.91	1.31	5.44**	-0.73
<b>Spacing</b>	5.80	1.14	3.97	1.48	11.90**	1.38

Student Responses						
Scenario	<u>EB option</u>		<u>Non-EB option</u>		<u>Comparison</u>	
	M	SD	M	SD	t	Cohen's d
<b>Generation</b>	5.56	1.49	5.31	1.27	3.62**	0.17
<b>Retrieval</b>	5.06	1.58	4.19	1.49	9.67**	0.56
<b>Interleaving</b>	3.69	1.73	5.35	1.29	16.16**	-1.08
<b>Spacing</b>	5.88	1.17	4.36	1.63	17.07**	1.06

Note: M: Mean, SD: Standard Deviation, EB: evidence-based vignette, Non-EB: non-evidence-based vignette.

\*p<0.05 \*\*p<0.001 \*\*\*p<0.0001

1: very ineffective

2: ineffective

3: somewhat ineffective

4: neither effective nor ineffective

5: somewhat effective

6: effective

7: very effective

Table 5. Mean percentage of students and faculty providing higher rating for the EB scenarios.

Scenario	<u>Percentage</u>		<u>Comparison</u>	
	Students	Faculty	$\chi^2$	Cramer's V
<b>Generation</b>	84.27%	92%	5.94*	-0.08
<b>Retrieval</b>	75.56%	71.81%	0.89	0.03
<b>Interleaving</b>	36.54%	38.51%	0.19	-0.01
<b>Spacing</b>	90.51%	90.54%	0.0002	-0.0004

Note:  $\chi^2$ : chi-squared test \*p<0.05 \*\*p<0.001 \*\*\*p<0.0001



Table 6. Multiple Regression Model for predicting USMLE step1 score on following teacher’s advice and students’ awareness of effective learning strategies.

<b>Step1 score</b>	<b>Coef</b>	<b>p</b>	<b>[CI]</b>
<b>Teacher advice</b>	<b>-13.21</b>	<b>0.03</b>	<b>[-25.45, -0.97]</b>
<i>Awareness of evidence-based study strategies</i>			
Testing	3.55	0.31	[-10.54, 3.43]
Flashcards	0.96	0.65	[-5.27, 3.34]
Recopy notes	0.97	0.66	[-5.44, 3.49]
Rereading	1.79	0.46	[-6.63, 3.04]
Outline	2.44	0.32	[-7.34, 2.45]
Underline	1.93	0.39	[-6.44, 2.56]
Diagram	2.57	0.26	[-7.12, 1.97]
Friends	2.52	0.25	[-6.87, 1.82]
Cram	2.51	0.31	[-7.51, 2.47]
Ask	0.30	0.89	[-4.76, 4.14]
<i>Reported use of various study strategies</i>			
Testing	1.45	0.85	[-17.79, 14.87]
Flashcards	0.08	0.98	[-10.84, 10.67]
Recopy notes	-1.91	0.74	[-9.86, 13.69]
Rereading	-2.0	0.69	[-12.33, 8.32]
Outline	0.11	0.98	[-10.65, 10.87]
Underline	0.03	0.99	[-11.67, 11.61]
Diagram	4.17	0.41	[-14.23, 5.88]
<b>Friends</b>	<b>-12.32</b>	<b>0.02</b>	<b>[-1.61, -23.03]</b>
<b>Cram</b>	<b>-11.67</b>	<b>0.02</b>	<b>[-1.27, -22.07]</b>
Ask	7.35	0.14	[-17.21, 2.49]
<i>Demographics</i>			
<b>Female Gender</b> (ref: male)	<b>-12.59</b>	<b>0.009</b>	<b>[-21.92, -3.25]</b>
<b>Age</b>	<b>-2.54</b>	<b>0.006</b>	<b>[-4.32, -0.76]</b>
<i>Year Med School</i>			
2 <sup>nd</sup>	-0.80	0.97	[-50.61, 49.00]
3 <sup>rd</sup>	-5.30	0.82	[-52.91, 42.31]
4 <sup>th</sup>	-7.46	0.83	[-76.94, 62.01]
<i>School</i>			
1	10.49	0.14	[-3.64, 24.62]
2	1.01	0.95	[-35.58, 37.61]
3	-9.89	0.08	[-21.28, 1.50]
Cons	408.01	0.001	[162.40, 653.61]
N	97		
R <sup>2</sup>	0.41		
RMSE	19.49		

Note. Coef:  $\beta$  coefficients, RMSE: Root Mean Square Error, R<sup>2</sup>=R-squared

N=97 represents students who self-reported USMLE score from 3 different schools.

## **Acknowledgements**

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## Introduction

Learning is defined as having knowledge and skills readily available from memory when necessary <sup>1</sup>. Decades of research in the fields of cognitive and educational psychology have found that learning is deeper and longer lasting when it is arduous <sup>2,3</sup>. Retrieval practice (recalling facts from memory), spacing (periodic practice) and generation (creating and solving problems before being taught the solution) are evidence-based learning strategies for stronger and durable retention of knowledge <sup>2</sup>. However, rereading, highlighting and massed practice (cramming) are often the preferred study strategies among college students <sup>4</sup>.

Learners are different and may have preferences on different learning formats (visual, written, auditory or kinesthetic). Nevertheless, the idea that students have distinct learning styles has been refuted because there is no scientific evidence supporting that students learn better when the manner of instruction fits these preferences <sup>5</sup>.

Metacognition was first described as a problem-solving technique by Flavell in 1979 and refers to a process of a higher order consciousness that involves active control of learning or the process of thinking about thinking <sup>6-7</sup>. Metacognition enables students to monitor the learning strategies they use to best benefit from instruction and is associated with higher academic achievement <sup>8-11</sup>. In contrast, lack of awareness of effective learning strategies has been identified as the source of poor academic performance for many students <sup>8,9</sup>.

Unfortunately, metacognition may be underutilized; students and teachers often use ineffective learning strategies and remain unaware of the evidence-based study tactics <sup>2,9,10</sup>. Cognitive science research in recent decades demonstrates that the most effective strategies are unintuitive, perhaps explaining why they are infrequently applied <sup>1-4</sup>.

Most of the published studies that have assessed learning strategies have used the Metacognition Awareness Inventory, which encompasses all learning skills, knowledge and regulation of learning. Most are single-centered, few explore specific learning techniques and health professions subjects, which is the purpose of this research<sup>3,12,13</sup>. Those studies which have explored specific learning techniques have focused on re-reading, highlighting, retrieval practice and testing but have not assessed interleaving, self-explanation, summarization, mnemonics, and distributed practice strategies<sup>3,4,12,13</sup>. To our knowledge, none of the previous studies assessed the awareness of effective learning strategies among health professions faculty. However, studies have called for greater faculty involvement in teaching metacognitive awareness and learning strategies to students to improve lifelong learning once in independent healthcare practice and students' academic performance<sup>8-10,14-17</sup>.

This study aimed to address the following research questions:

1. What is the level of awareness of evidence-based learning techniques among health professions students and faculty and do the two groups differ in their awareness?
2. Are students' awareness of evidence-based learning techniques, and/or their self-reported adherence to faculty guidance on study habits, associated with students' academic achievement?

## **Methods**

### *Study design*

This is a multicenter, international, cross-sectional, online survey-based study assessing two populations: health professions students and faculty.

### *Ethical approvals*

The Harvard Faculty of Medicine Human Research Protection Program approved this study under the protocol # IRB17-1005. The study submission met the criteria for exemption per the regulations found at 45 CFR 46.101(b)(2). As such, additional IRB review was not required (Appendix 1). The study was also approved by the Harvard Medical School Academy (Appendix 2).

### *Instrument*

We used a questionnaire that was previously utilized in a population of undergraduate college students<sup>18-21</sup>. We conducted pilot testing of the survey among 10 medical students and 10 faculty at Harvard Medical School to assess the instrument's clarity, flow, and time for completion. Minor language adjustments to include medical terminology were made to improve authenticity of case scenarios. We also added a question regarding self-report of USMLE step 1 scores. The final survey instruments are included as Appendix 3 (students) and Appendix 4 (faculty). At the end of the survey, participants received an invitation to view a YouTube video on effective

study strategies (<https://youtu.be/CPxSzxylRCI>). Survey data was collected using Qualtrics software, Version [01/2018] of Qualtrics Copyright© (Provo, UT, USA, 2017).

Link for students: [https://hms.az1.qualtrics.com/jfe/form/SV\\_720WhdyfC0fFQpf](https://hms.az1.qualtrics.com/jfe/form/SV_720WhdyfC0fFQpf)

Link for faculty: [https://hms.az1.qualtrics.com/jfe/form/SV\\_7ah8Mymbw84qsWF](https://hms.az1.qualtrics.com/jfe/form/SV_7ah8Mymbw84qsWF)

### *Study Population*

Six health professions schools participated in this study: Harvard Medical School, Charles E. Schmidt College of Medicine at Florida Atlantic University (FAU), Central Michigan University, University of Michigan School of Dentistry, Ben Gurion University of the Negev, Joyce & Irving Goldman School of Medicine, Israel and Medical University of Poland. Five schools enrolled medical students and one included dental students (University of Michigan School of Dentistry) across all years of undergraduate education.

Each center had a study site leader who received school-unique survey links for both students and faculty from the coordinating center at Harvard Medical School. The site leader delivered the survey links to their local participants. Eligible faculty were those teaching the students eligible for this study as defined by the study site leader. The survey distribution protocol included 3 deployments with reminders every 2 weeks. See Figure 1 for details and response rates. All data was collected from October 2017 through January 2018.

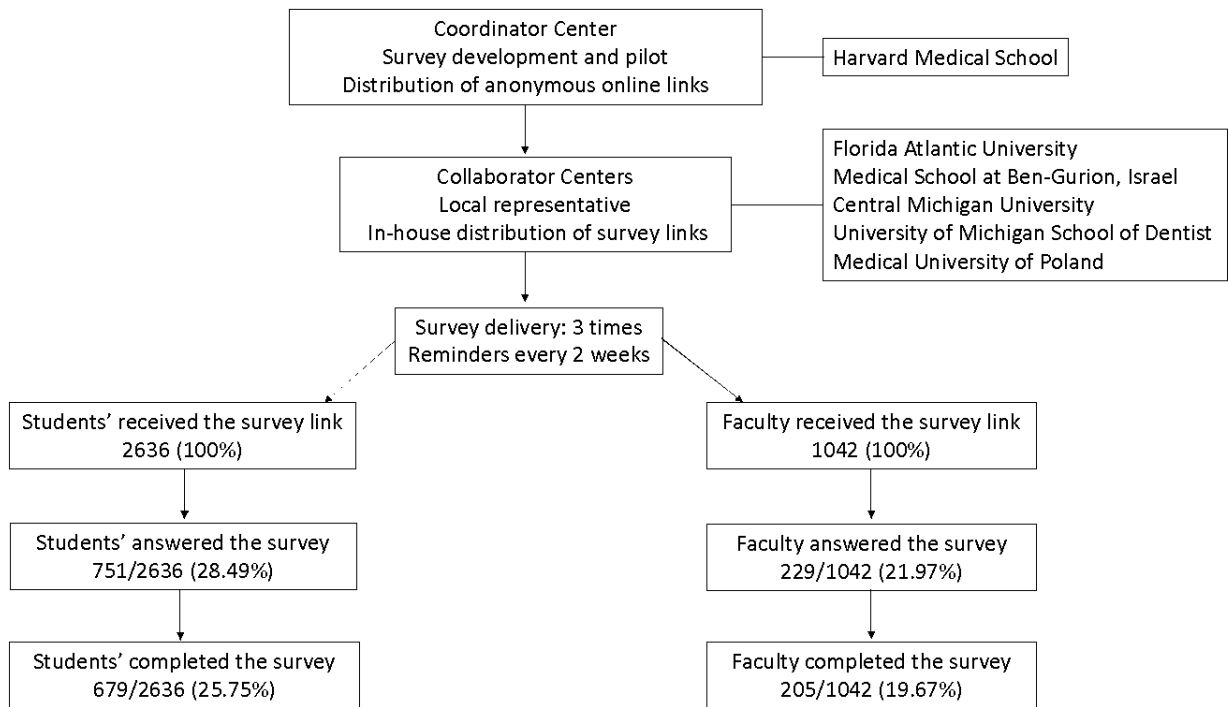


Figure 1- Study flow chart and participants' survey response rate

### Statistical Analysis

The data analysis was performed using StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC. Awareness of evidence-based learning techniques was measured using individual survey items that directly asked about learning strategies (e.g. "Which of the following best describes your pattern of study?"; Which of the following study strategies do you use regularly?) and also using responses to survey vignettes (i.e. whether the students/faculty correctly identify the more effective teaching techniques). These measures were summarized descriptively using proportions and means with standard deviations.

The questionnaire included 4 case scenarios to assess participants' awareness of practical situations regarding evidence-based learning strategies such as generation, retrieval, interleaving and spacing (Appendix 3 and 4). For each case scenario, each subject was coded as 0 if the evidence-based support option was given a higher rating than the non-evidence-based option and 1 if a lower grade was given to the evidence-based options. The proportions of

students and faculty correctly giving a higher rating to the evidence-based option were than compared with a chi-squared test.

Group comparison analyses were conducted with chi-squared tests and effect sizes were calculate with Cohen's d or Cramer's V. Academic performance for students were assessed by self-reported USMLE (United States Medical Licensing Examination) Step 1 scores. Relationships between both students' awareness of evidence-based learning techniques and their report of following faculty advisement regarding study strategies and the students' academic achievement were assessed using a nonparametric correlation coefficient and linear regression analyses.

In order to answer study's second research question (the relationship between students' awareness of evidence-based learning techniques and students' report of following faculty guidance on study habits with the students' academic achievement) we used multiple regression models to predict students' USMLE step1, controlling for gender, age and school.

## **Results**

### *Participant Characteristics*

The number of students and faculty eligible for the survey and the response rate varied between sites. For the purpose of this study we have analyzed the response rate data combining all schools. As shown in Figure 1, survey response rate was higher among students than faculty, 679/2636 (26%) versus 205/1042 (20%) respectively.

Characteristics of the student and faculty participants are shown in Table 1. The largest student participation came from Harvard Medical School 240/679 (35%) and the largest faculty participation came from Central Michigan University 53/205 (26%). The first 3 years of school



were more represented in the students' sample than the final years. More faculty taught in the pre-clinical curriculum 60/143 (42%) than in other curricular phases and the majority were assistant professors, associate professors, or full professors. Faculty had a mean of 15.33 (SD=10.43) years of teaching experience, demonstrating a tendency for experienced faculty to participate in this survey.

Table 1. Characteristics of Student and Faculty participants in a survey of awareness of effective learning strategies in health professions school

<b>Students' Variables</b>		<b>Faculty Variables</b>	
<i>School</i>	<i>N (%)</i>		<i>N / %</i>
Harvard Medical School	240 (35%)	Harvard Medical School	15 (7%)
Florida Atlantic University	74 (11%)	Florida Atlantic University	47 (23%)
Ben Gurion University, Israel	97 (14%)	Medical School at Ben Gurion	25 (12%)
University of Michigan School	176 (26%)	University of Michigan School	46 (22%)
Central Michigan University	80 (12%)	Central Michigan University	53 (26%)
Medical University of Poland	12 (2%)	Medical University of Poland	19 (10%)
<i>N total</i>	679 (100%)	<i>N total</i>	205 (100%)
<i>Gender</i>			
Men	349 (58%)	Men	74 (52%)
Women	244 (41%)	Women	63 (44%)
Other	1 (0.2%)	Other	1 (0.5%)
Prefer not to answer	5 (0.8%)	Prefer not to answer	5 (3.5%)
<i>N total</i>	599 (100%)	<i>N total</i>	143 (100%)
<i>Year of medical school</i>		<i>Teaching area</i>	
1 <sup>st</sup>	116 (27%)	Pre-clinical students	60 (42%)
2 <sup>nd</sup>	117 (27%)	Clinical students	45 (31%)
3 <sup>rd</sup>	106 (25%)	Residency	38 (27%)
4 <sup>th</sup>	75 (17%)	<i>N total</i>	143 (100%)
Over 4 <sup>th</sup>	19 (4%)		
<i>N total</i>	433 (100%)		
<i>Specialty desired</i>		<i>Academic rank</i>	
Internal Medicine	217 (36%)	Professor	27 (19%)
Pediatrics	32 (5%)	Associate Professor	38 (27%)
OBGYN	17 (3%)	Assistant Professor	51 (36%)
General Surgery	39 (7%)	Adjunct professor	6 (4%)
Neurology	16 (3%)	Graduate Assistant	9 (6%)
Psychiatry	14 (2%)	Instructor	7 (5%)
Family Medicine	13 (2%)	Academic Adviser	2 (1%)
Other	86 (14%)	Other	3 (2%)
Not decided	164 (28%)	<i>N total</i>	143 (100%)
<i>N total</i>	598 (100%)		
<i>Continuous Variables</i>	<i>Mean / SD</i>	<i>Mean / SD</i>	
Age	25.60 / 3.93	Teaching Years	15.33 / 10.43
USMLE – step1	235 / 20.94	Percentage teaching time	36.58 / 26.55

Note: *N*: Number, %: percentage, SD: standard deviation, OBGYN: Obstetrics and Gynecology  
*N* varies along the survey due to variable participant response to each question.

### *Student and Faculty Awareness of Evidence Based Study Techniques*

Students infrequently reported using evidence-based study techniques (Table 2). Most students 558/679 (82%) reported that they do not study the way they do because a teacher taught them to do this way (Table 2). Over half of students surveyed 389/679 (57%) stated that they decide to study next whatever is due soonest, while just over a quarter of the students 173/679 (26%) actually plan their study schedule in advance. Moreover, the majority of students 465/679 (68%) do not return to course material for review once the course has ended. Many students 298/679 (44%) reread sections they have underlined/highlighted/marked. Only 229/669 (34%) used self-testing because they learned more that way than from rereading, showing a general lack of awareness of the testing effect.

Even though most students said they would test themselves with questions or practice problems 485/661 (73%), many students are still practicing non-evidence-based study techniques such as rereading 317/661 (48%), highlighting 386/661 (58%) and cramming 281/661 (43%). Finally, approximately half of all students 347/661 (53%) believed they have a specific learning style (Table 2).

Table 2. Students' responses to a survey of awareness of effective learning strategies

Questions	Choices	<i>N</i> / <i>N</i> total (%)
<b>Would you say that you study the way you do because a teacher (teachers) taught you to study that way?</b>	Yes	121/679 (18%)
	No	558/679 (82%)
<b>How do you decide what to study next?</b>	Whatever's due soonest/overdue	389/679 (57%)
	Whatever I haven't studied for the longest time	28/679 (4%)
	Whatever I find interesting	28/679 (4%)
	Whatever I feel I'm doing the worst in	61/679 (9%)
	I plan my study schedule ahead of time and I study whatever I've scheduled	173/679 (26%)
<b>Do you usually return to course material to review it after a course has ended?</b>	Yes	214/679 (32%)
	No	465/679 (68%)
<b>When you study do you typically read a text book/article/other source material more than once?</b>	Yes, I reread whole chapters/articles	98/679 (14%)
	Yes, I reread sections that I underlined/highlighted/marked	298/679 (44%)
	Not usually	283/679 (42%)

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<b>If you quiz yourself while you study (either using a quiz at the end of a chapter or a practice quiz or flashcards or something else) why do you do so?</b>	I learn more that way than I would through rereading	229/669 (34%)
	To figure out how well I have learned the information I'm studying	268/669 (40%)
	I find quizzing more enjoyable than reading	53/669 (8%)
	I usually do not quiz myself	119/669 (18%)

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<b>Imagine that in the course of studying you become convinced that you know the answer to a certain question (e.g., the definition of a medical term). What would you do?</b>	Make sure to study (or test yourself on) it again later	195/669 (29%)
	Put it aside and focus on other material	474/669 (71%)
<b>Which of the following best describes your pattern of study?</b>	I most often space out my study sessions over multiple days/weeks	471/669 (70%)
	I most often do my studying in one session before the test	198/669 (30%)
<b>Which of the following study strategies do you use regularly? (Please check off all that apply.)</b>	test yourself with questions or practice problems	485/661 (73%)
	use flashcards	217/660 (33%)
	recopy your notes	219/661 (33%)
	reread chapters, articles, notes, etc.	317/661 (48%)
	make outlines while reading	323/661 (49%)
	underline or highlight while reading	386/661 (58%)
	study with friends	308/661 (47%)
	“cram” lots of information the night before the test	263/661 (40%)
	ask questions or verbally participate during class	281/661 (43%)
	other (Please describe)	231/660 (35%)
		20/661 (3%)

<b>Do you believe you have a specific learning style (e.g., are you visual or verbal learner)?</b>	Yes	347/661 (53%)
	No	53/661 (8%)
	No, I learn best through multiple methods	261/661 (39%)

*N* varies along the survey due to variable participant response to each question.

Although most students reported their study habits were not influenced by their teachers (Table 2), the majority of faculty said they discussed study techniques in class 106/205 (52%) or recommend effective study strategies for their students 125/157 (80%). Most teachers 108/158 (68%) are aware that students choose to study whatever is due soonest despite agreeing that students should plan their study schedule ahead of time. Some faculty don't return to earlier material throughout his/her course 37/157 (24%) showing underutilization of the spaced repetition learning technique. A high proportion of teachers 72/156 (46%) explicitly said they would not use the spacing strategy in class. In addition, a substantial proportion of faculty recommended non-evidence-based study techniques to their students such as rereading 46/147 (31%), making outlines 54/147 (36%) or highlighting 45/147 (31%). Of those faculty who did report that students should quiz themselves 138/155 (89%), a minority 56/155 (36%) said they did so for the evidence-based reason that testing promotes learning. Finally, 142/156 (91%) of faculty endorsed the belief that students have different learning styles and 112/141 (79%) reporting they teach to accommodate those differences (Table 3).

Table 3. Faculty responses to a survey of awareness of effective learning strategies

Questions	Choices	Response
<b>Do you discuss study techniques in class?</b>	Yes	106/205 (52%)
	No	99/205 (48%)
<b>How often do you discuss study techniques?</b>	A few times a week	7/88 (8%)
	About once a week	25/88 (28%)
	Before tests/major assignments	26/88 (30%)
	About once every semester	22/88 (25%)
	Other	8/88 (9%)
<b>How do you think your students choose to study?</b>	Whatever's due soonest/overdue	108/158 (68%)
	Whatever they haven't studied for the longest time	3/158 (2%)
	Whatever they find interesting	16/158 (10%)
	Whatever they feel they're doing the worst in	14/158 (9%)
	They plan their study schedule ahead of time and they study whatever they have scheduled	17/158 (11%)
<b>How do you think your students should choose to study?</b>	Whatever's due soonest/overdue	7/158 (4%)
	Whatever they haven't studied for the longest time	0/158 (0%)
	Whatever they find interesting	15/158 (10%)
	Whatever they feel they're doing the worst in	25/158 (16%)
	They plan their study schedule ahead of time and they study whatever they have scheduled	111/158 (70%)
<b>Do you return to earlier material in later sections? (e.g., reviewing week 1 material near the middle of the semester)</b>	Yes	120/157 (76%)
	No	37/157 (24%)
<b>Do you recommend study techniques to students, either in class or during out of class meetings?</b>	Yes	125/157 (80%)
	No	32/157 (20%)

<b>if yes, which of the following study techniques do you recommend students use regularly? (please check off all that apply)</b>	test yourself with questions or practice problems	100/147	(68%)
	use flashcards	37/147	(25%)
	recopy your notes	11/147	(8%)
	reread chapters, articles, notes, etc.	46/147	(31%)
	make outlines while reading	54/147	(37%)
	underline or highlight while reading	45/147	(31%)
	make diagrams, charts, or pictures	64/147	(44%)
	study with friends	67/147	(46%)
	“cram” lots of information the night before the test	3/147	(2%)
	ask questions or verbally participate during class	100/147	(68%)
other (Please describe)	25/147	(17%)	
<b>If you do discuss study techniques in class, do you think students use those techniques?</b>	Yes	22/146	(15%)
	Yes for my class, but not necessarily for others	10/146	(7%)
	No	8/146	(5%)
	Some do, some do not	106/146	(73%)
<b>If you think students should quiz themselves (either using a quiz at the end of a chapter, a practice quiz, flashcards or something else), why should they do so?</b>	They will learn more that way than through rereading	56/155	(36%)
	To figure out how well they have learned the information they’re studying	82/155	(53%)
	I do not think quizzing will necessarily benefit	17/155	(11%)
<b>Do you use/encourage spacing techniques in class? (e.g., leaving days/weeks for students to study for the next exam or returning to information after discussing it)</b>	Yes	84/156	(54%)
	No	72/156	(46%)
<b>Do you believe students have</b>	Yes	142/156	(91%)



<b>different learning styles (e.g., visual vs. auditory learners)?</b>	No	14/156	(9%)
<b>Do you teach to accommodate those differences?</b>	Yes	112/141	(79%)
	No	29/141	(21%)

*N* varies along the survey due to variable participant response to each question.

As shown in Table 2 and 3, there are notable differences between students and faculty regarding following the proportion who reported students followed teachers' study advice, the proportion who returned to earlier material (either when studying, if a student or when teaching, if faculty), and who believed in learning styles. These differences depict a mismatch between what is being reported by faculty and what is being done by students and what is perceived from each group regarding learning styles.

#### *Student and Faculty Ratings of Evidence and Non-Evidence Based Case Scenarios*

The survey also encompassed four case scenarios to assess participants' metacognitive awareness of effective learning strategies (Table 4). Three scenarios including generation, retrieval practice and spacing were presented; participants on average ranked these evidence-based options higher than the non-evidence-based option. However, for the interleaving scenario both faculty and students ranked the evidence-based scenario option lower than the non-evidence-based option. All comparisons were statistically significant (Table 5).

Table 4. Participants' mean ratings and standard deviations for evidence-based (EB) and non-evidence based (Non-EB) options for the learning scenario questions.

Faculty Responses						
Scenario	<u>EB option</u>		<u>Non-EB option</u>		<u>Comparison</u>	
	M	SD	M	SD	t	Cohen's d
Generation	5.87	1.19	5.2	0.94	6.99**	0.62
Retrieval	4.81	1.45	4.18	1.39	3.64**	0.43
Interleaving	3.82	1.63	4.91	1.31	5.44**	-0.73
Spacing	5.80	1.14	3.97	1.48	11.90**	1.38

Student Responses						
Scenario	<u>EB option</u>		<u>Non-EB option</u>		<u>Comparison</u>	
	M	SD	M	SD	t	Cohen's d
Generation	5.56	1.49	5.31	1.27	3.62**	0.17
Retrieval	5.06	1.58	4.19	1.49	9.67**	0.56
Interleaving	3.69	1.73	5.35	1.29	16.16**	-1.08
Spacing	5.88	1.17	4.36	1.63	17.07**	1.06

Note: M: Mean, SD: Standard Deviation, EB: evidence-based vignette, Non-EB: non-evidence-based vignette.

\*p<0.05 \*\*p<0.001 \*\*\*p<0.0001

1: very ineffective

2: ineffective

3: somewhat ineffective

4: neither effective nor ineffective

5: somewhat effective

6: effective

7: very effective

Table 5. Mean percentage of students and faculty providing higher rating for the EB scenarios.

Scenario	<u>Percentage</u>		<u>Comparison</u>	
	Students	Faculty	$\chi^2$	Cramer's V
Generation	84.27%	92%	5.94*	-0.08
Retrieval	75.56%	71.81%	0.89	0.03
Interleaving	36.54%	38.51%	0.19	-0.01
Spacing	90.51%	90.54%	0.0002	-0.0004

Note:  $\chi^2$ : chi-squared test \*p<0.05 \*\*p<0.001 \*\*\*p<0.0001

Only the generation scenario showed a statistical difference between faculty and students awareness, with faculty more likely to correctly assign a higher rating to the generation scenario ( $\chi^2=5.94$ ,  $V=-0.08$ ). The majority of both faculty and students incorrectly assigned a higher rating to non-evidence-based option in the interleaving scenario, with no statistical difference between students and faculty ( $\chi^2=0.19$ ,  $V=-0.01$ ) (Table 5).

#### *Relationship between awareness of evidence-based study habits and test performance*

We modeled students' self-reported test performance with a multiple regression model that included awareness of evidence-based study strategies and reported use of various study strategies, students' report of following faculty guidance on study habits, and demographic variables. Table 6. Students who reported studying the way they do because a teacher taught them that way reported lower step 1 grades, controlling for demographic variables, awareness and use of evidence-based study habits, compared to those students who did not report following faculty advice regarding study habits ( $p=0.03$ ,  $d=0.54$ , Figure 2).

Two study habits were significantly associated with lower USMLE scores: reporting studying with friends ( $\beta=-12.32$ ,  $p:0.02$ ) and reporting cramming before tests ( $\beta=-11.67$ ,  $p:0.02$ ), when controlling for other variables. The only demographic variables reaching statistical significance in the regression model were gender and age, with males and younger students significantly associated with higher USMLE step 1 scores. The multiple regression model for prediction of academic achievement reached  $R^2=0.41$ , representing that 41% of USMLE step1 score were associated with the variables analyzed (Table 6).

Table 6. Multiple Regression Model for predicting USMLE step1 score on following teacher’s advice and students’ awareness of effective learning strategies.

<b>Step1 score</b>	<b>Coef</b>	<b>p</b>	<b>[CI]</b>
<b>Teacher advice</b>	<b>-13.21</b>	<b>0.03</b>	<b>[-25.45, -0.97]</b>
<i>Awareness of evidence-based study strategies</i>			
Testing	3.55	0.31	[-10.54, 3.43]
Flashcards	0.96	0.65	[-5.27, 3.34]
Recopy notes	0.97	0.66	[-5.44, 3.49]
Rereading	1.79	0.46	[-6.63, 3.04]
Outline	2.44	0.32	[-7.34, 2.45]
Underline	1.93	0.39	[-6.44, 2.56]
Diagram	2.57	0.26	[-7.12, 1.97]
Friends	2.52	0.25	[-6.87, 1.82]
Cram	2.51	0.31	[-7.51, 2.47]
Ask	0.30	0.89	[-4.76, 4.14]
<i>Reported use of various study strategies</i>			
Testing	1.45	0.85	[-17.79, 14.87]
Flashcards	0.08	0.98	[-10.84, 10.67]
Recopy notes	-1.91	0.74	[-9.86, 13.69]
Rereading	-2.0	0.69	[-12.33, 8.32]
Outline	0.11	0.98	[-10.65, 10.87]
Underline	0.03	0.99	[-11.67, 11.61]
Diagram	4.17	0.41	[-14.23, 5.88]
<b>Friends</b>	<b>-12.32</b>	<b>0.02</b>	<b>[-1.61, -23.03]</b>
<b>Cram</b>	<b>-11.67</b>	<b>0.02</b>	<b>[-1.27, -22.07]</b>
Ask	7.35	0.14	[-17.21, 2.49]
<i>Demographics</i>			
<b>Female Gender</b> (ref: male)	<b>-12.59</b>	<b>0.009</b>	<b>[-21.92, -3.25]</b>
<b>Age</b>	<b>-2.54</b>	<b>0.006</b>	<b>[-4.32, -0.76]</b>
<i>Year Med School</i>			
2 <sup>nd</sup>	-0.80	0.97	[-50.61, 49.00]
3 <sup>rd</sup>	-5.30	0.82	[-52.91, 42.31]
4 <sup>th</sup>	-7.46	0.83	[-76.94, 62.01]
<i>School</i>			
1	10.49	0.14	[-3.64, 24.62]
2	1.01	0.95	[-35.58, 37.61]
3	-9.89	0.08	[-21.28, 1.50]
Cons	408.01	0.001	[162.40, 653.61]
N	97		
R <sup>2</sup>	0.41		
RMSE	19.49		

Note. Coef:  $\beta$  coefficients, RMSE: Root Mean Square Error, R<sup>2</sup>=R-squared

N=97 represents students who self-reported USMLE score from 3 different schools.

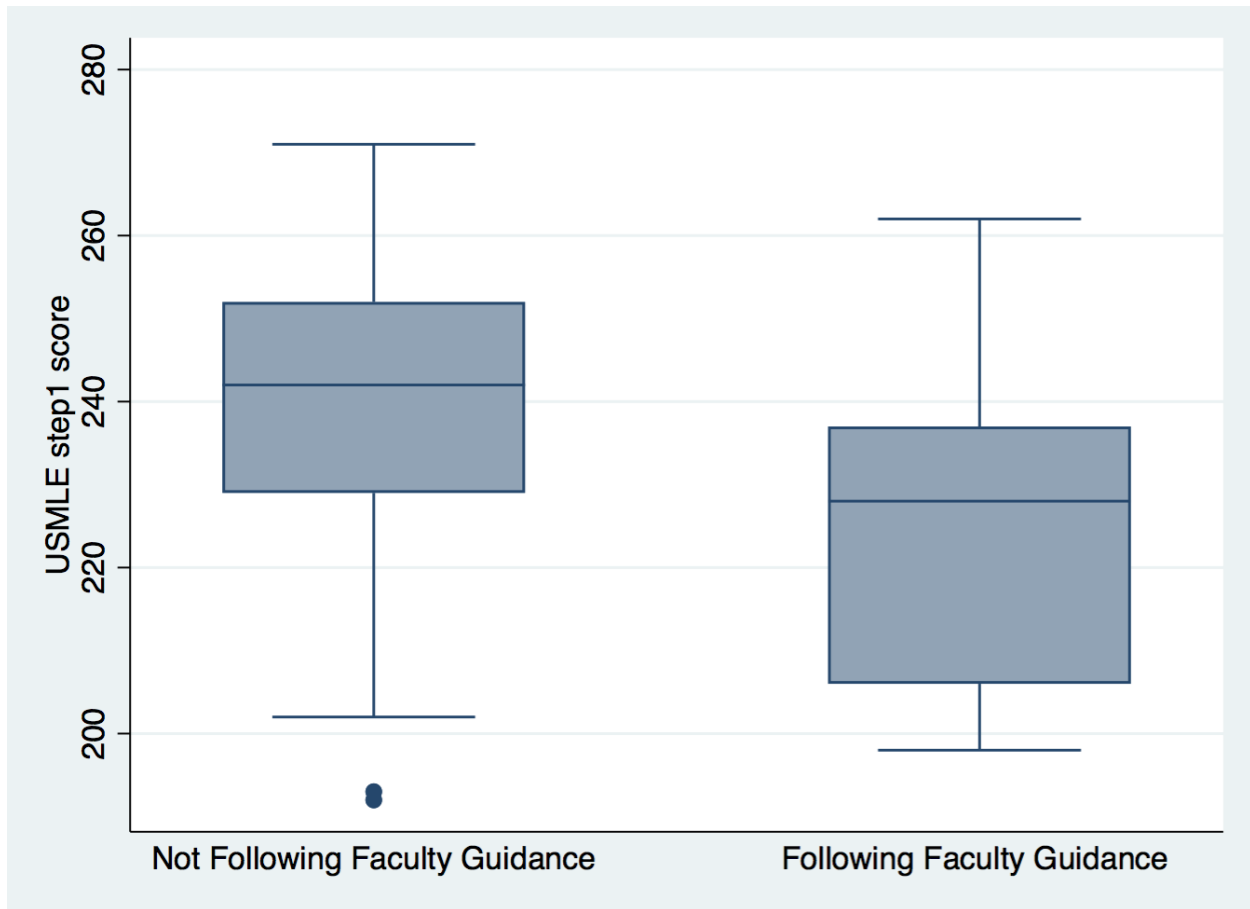


Figure 2. Box plot for student's self-reported USMLE step 1 scores based on following faculty guidance on how to study.  
 Note: Following faculty guidance how to study: Would you say that you study the way you do because a teacher (teachers) taught you to study that way?

## Discussion

The results of this international multicenter study demonstrate a moderate awareness of evidence-based learning strategies among health professions students and faculty along with persistence of several misconceptions about learning. Overall our findings follow patterns previously shown in undergraduate general education<sup>18,19,21</sup>, with a few notable differences. Many health professions students reported spacing out study sessions over multiple days and weeks showing a positive awareness and use of this evidence-based study technique. College students report lower ranking of this study habit<sup>18,21</sup>. This may be because healthcare students are more motivated to retain

the information they are studying over time, although our study did not explore this directly. Making diagrams, pictures or charts is more popular among health professions students than college students<sup>18,21</sup>, while using flashcards is less common among health care students compared to college students<sup>18,21</sup>. Health professions faculty similarly reported recommending making diagrams and charts when studying at higher rates than college instructors. These findings may reflect the need to use higher order strategies such as concept mapping to learn the more complex information presented in health professional school, or explicit strategies taught in new curricular methods such as Problem Based Learning (PBL), Team Based Learning (TBL), and case-Based Collaborative Learning (CBCL)<sup>22</sup>.

Importantly, most of the case-scenarios were correctly assigned by faculty and students, with the exception to the interleaving scenario. Interleaving practice (studying in an intermingled way alternating between different problems) is not intuitive and can be faced by scholars as an undesirable difficulty. However, cognitive science has demonstrated that interleaving is one of the most effective learning strategies<sup>1-3,23</sup>.

Cramming is less commonly reported by health professions students when compared with college population<sup>18,21</sup>, although is still quite prevalent. New curriculum formats may promote a learning environment where spacing is stimulated throughout techniques such as flipped classroom activities, case discussions, and team assessments<sup>24</sup>. Importantly, in our study students who cram reported lower USMLE step 1 scores, emphasizing the importance of spacing for students and faculty<sup>25,26</sup>.

Studying with friends was also less common in our population compared to college populations<sup>18,21</sup> and was associated with lower USMLE scores. New curriculums methods may promote frequent team interaction leading students to study more in their own in their study time. Similar to cramming, students who self-reported studying with friends had on average lower USMLE step 1 grades. The social nature of studying has been studied with conflicting results that relate to

two competing theories. Global-competence theory predicts a positive association between popularity and academic achievement while the overachiever theory suggests higher grades result in fewer friends leading high performing students to study independently <sup>27</sup>.

Both health professions and college faculty reported they recommend study techniques to students either in class or outside class time. However, only 121/679 (18%) of health care students reported their study habits were based on faculty instruction or guidance; a similar pattern was observed among 3 other studies that assessed college students<sup>18,19,21</sup>. Interestingly, students in our sample who did report studying based on faculty guidance had lower Step 1 scores. This may be due to reverse causation, with lower performing students seeking out faculty guidance to improve their performance or faculty lack of awareness for guidance evidence-based techniques.

Finally, we found a notable endorsement of learning styles theory in health professions faculty 142/156 (91%), which is similar to college faculty<sup>21</sup>. These theories became popular and widespread in the 1970's and often advocated teaching to students' preferred mode of content presentation such as visual, auditory or kinesthetic. Majority of faculty in our study and similarly for college teachers<sup>21</sup> said they teach to accommodate the difference of students learning styles demonstrating unawareness and confirmation biases with these theories and a need for faculty development in this area.

### *Potential and practical impact*

Learning is a complex activity and our findings suggest new avenues for health professions education research and practice. This study is an opportunity to contribute to student and faculty development due to high levels of inconstancy and misconception regarding evidence-based learning techniques. Promoting metacognition begins with building an awareness among learners that metacognition exists, differs from cognition, and increases academic success<sup>8,10,12,14</sup>.

While planning a curriculum, health professions educators should focus on learning how to learn and higher-order thinking procedures in addition to content. Medical school faculty can foster the development of medical expertise by enabling their students to develop metacognitive capabilities<sup>10,14</sup>. Penn State College of Medicine for example, developed a cognitive skills program that promotes metacognition activities to their students empowering them to learn effectively and efficiently<sup>28</sup>.

### *Limitations*

Our study has several limitations. The response rate among subjects was approximately 25% and may not reflect the opinion of all health care students and faculty. Participants willing to answer surveys may be those who care more, or know more, about the topic and might bias the results. Nevertheless, many misconceptions were identified even in this population. Responses are self-reported and may not reflect participants' true opinions. To minimize this limitation, we clearly stated that participation was voluntary and anonymous.

### **Conclusion**

There is a wide gap between what science has learned about teaching and learning and what our participants are practicing. We seek to emphasize that some health professions faculty and students are currently unaware of core components of evidence-based learning techniques. Our findings are an opportunity to foster growth mindset among health professions faculty and students through reexamining one's assumptions and biases of teaching and learning techniques and embracing desirable difficulties<sup>29</sup>. It is time to leverage medical education to a new era by promoting and using cognitive science in health professions settings. By incorporating effective metacognitive



principles into the learning environment in the health professions, the long-term benefits may ultimately translate into higher quality of care for patients.

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## Appendices

### Appendix 1. Harvard Faculty of Medicine IRB approval



Harvard Faculty of Medicine  
Office of Human Research Administration  
90 Smith Street, 3rd Floor  
Boston, MA 02120  
Federalwide Assurance FWA00007071

#### Notification of Initial Study Exemption Determination

June 26, 2017

Felipe Piza  
felipe.piza@einstein.br

**Protocol Title:** Assessing metacognition awareness of learning strategies among medical students and medical faculty  
**Principal Investigator:** Felipe Piza  
**Protocol #:** IRB17-1005  
**Funding Source:** None  
**IRB Review Date:** 6/26/2017  
**IRB Effective Date:** 6/26/2017  
**IRB Review Action:** Exempt

This Initial Study submission meets the criteria for exemption per the regulations found at 45 CFR 46.101(b)(2). As such, additional IRB review is not required. For international research, the Principal Investigator is required to comply with any applicable local laws, legislation, regulations, and/or policies. Additionally, if local IRB/ethics review is required, it must be obtained before any human subjects research activities are conducted in the field. If assistance with applicable local requirements is needed, please contact the Harvard Faculty of Medicine IRB office.

The determination that your research is exempt does not expire, and you will not file annual renewals. If changes to the research are proposed that would alter the IRB's original exemption determination, they should be submitted in ESTR by using the Modify Study button. If unsure, contact the Harvard Faculty of Medicine IRB office.

The IRB made the following determinations:

- Research Information Security Level: The research is classified, using Harvard's Data Security Policy, as Level 2 Data.

Please contact me at 617.432.5132 or kninsala@hsph.harvard.edu with any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Keren-Nicole Insalaco".

Keren-Nicole Insalaco  
Sr. IRB Review Specialist

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University Area IRB <http://cuhs.harvard.edu>  
Longwood Medical Area IRB <http://www.hsph.harvard.edu/ohra/>

## Appendix 2. Harvard Medical School Academy approval



**Harvard Medical School Academy**  
260 Longwood Avenue • TMEC 384 • Boston, MA 02115

Dear Dr. Piza, MD,

Your study, "*Assessing study strategies awareness among medical students and faculty*" has been approved by the HMS Academy.

We are sending a copy of the approval notice and to the HMS IRB. They will assist you with next steps in the HMS IRB review process.

Thank you and please let us know if you have questions.

The Academy

**The Academy | Harvard Medical School**  
260 Longwood Ave | TMEC 384 | Boston MA 02115  
T: 617-432-5401 | F: 617-432-7850 | E: [Academy@hms.harvard.edu](mailto:Academy@hms.harvard.edu)  
[The Academy at Harvard Medical School](#)

Cc: Kimberley Serpico, HMS IRB

### Appendix 3. Student's survey questionnaire

1. Would you say that you study the way you do because a teacher (teachers) taught you to study that way?

- Yes
- No

2. How do you decide what to study next?

- Whatever's due soonest/overdue
- Whatever I haven't studied for the longest time
- Whatever I find interesting
- Whatever I feel I'm doing the worst in
- I plan my study schedule ahead of time and I study whatever I've scheduled

3. Do you usually return to course material to review it after a course has ended?

- Yes
- No

4. When you study do you typically read a text book/article/other source material more than once?

- Yes, I reread whole chapters/articles
- Yes, I reread sections that I underlined/highlighted/marked
- Not usually

5. If you quiz yourself while you study (either using a quiz at the end of a chapter or a practice quiz or flashcards or something else) why do you do so?

- I learn more that way than I would through rereading
- To figure out how well I have learned the information I'm studying
- I find quizzing more enjoyable than reading
- I usually do not quiz myself

6. Imagine that in the course of studying you become convinced that you know the answer to a certain question (e.g., the definition of a medical term). What would you do?

- Make sure to study (or test yourself on) it again later
- Put it aside and focus on other material

7. Which of the following best describes your pattern of study?

- I most often space out my study sessions over multiple days/weeks
- I most often do my studying in one session before the test

8. Which of the following study strategies do you **use** regularly? (Please check off all that apply.)

- test yourself with questions or practice problems
- use flashcards
- recopy your notes
- reread chapters, articles, notes, etc.
- make outlines while reading
- underline or highlight while reading
- make diagrams, charts, or pictures
- study with friends
- “cram” lots of information the night before the test
- ask questions or verbally participate during class
- other (Please describe) \_\_\_\_\_

9. Do you believe you have a specific learning style (e.g., are you visual or verbal learner)?

- Yes
- No
- No, I learn best through multiple methods



10. The next section will present pairs of course or study scenarios. You will be asked to rate each scenario. Two assignments ask students to learn the list of cranial nerves using a mnemonic device. **Assignment A** includes a commonly used mnemonic device provided by the instructor to assist students in their learning. **Assignment B** asks students to create their own mnemonic device to assist their learning. After two weeks, all students are asked to list the cranial nerves in order. Please give your rating for **assignment A** for learning cranial nerves

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

11. Please give your rating for **assignment B** for learning cranial nerves

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

12. In two different classes, a 275-word prose passage about pathophysiology is presented. In **Class A**, students first study the passage for seven minutes, and then are asked to write down from memory as much of the material from the passage as they can. In **Class B**, students first study the passage for seven minutes, and then are asked to study the passage again for another seven minutes. After one week, all students are asked to recall as much of the passage as they can remember. Please give your rating for **class A** for recalling the passage after 1 week.

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective

- Somewhat effective
- Effective
- Very effective

13. Please give your rating for **class B** for recalling the passage after 1 week.

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

14. Two professors present 6 slides showing each of 12 tissue types (72 slides total).

**Professor A** presents all six slides of a single tissue (i.e., grouped), and then moves on to the next set of tissues' six slides, and so on, until all slides have been presented.

**Professor B** presents the various tissues' slides in an intermingled fashion (i.e., mixed), such that a single slide of a particular tissue would be followed by a different tissue. Please give your rating for **professor A's** teaching technique

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

15. Please give your rating for **professor B's** teaching technique

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

16. Two students are studying for an exam. **Student A** studies the two days leading up to the exam. **Student B** starts studying two weeks before the exam, studying a little bit everyday. Both students study the same number of hours. Please give your rating for **Student A's** study strategy

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

17. Please give your rating for **Student B's** study strategy

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

18. Which of the study strategies do you think is **most effective** for longer term retention? Please click to drag and drop for **ranking** from 1-11. 1 as the most effective and 11 as the least effective.

- \_\_\_\_\_ test yourself with questions or practice problems
- \_\_\_\_\_ use flashcards
- \_\_\_\_\_ recopy your notes
- \_\_\_\_\_ reread chapters, articles, notes, etc.
- \_\_\_\_\_ make outlines while reading
- \_\_\_\_\_ underline or highlight while reading
- \_\_\_\_\_ make diagrams, charts, or pictures
- \_\_\_\_\_ study with friends
- \_\_\_\_\_ “cram” lots of information the night before the test
- \_\_\_\_\_ ask questions or verbally participate during class
- \_\_\_\_\_ other (Please describe)

19. What is your current USMLE Step 1 score? - note this is anonymous and survey software does not retain any information about you as an individual

- USMLE\_score \_\_\_\_\_
- I haven't taken Step 1
- Prefer not to answer

*Display This Question:*

*If What is your current USMLE Step 1 score? = I haven't taken Step 1*

20. What is your MCAT score? - note this is anonymous and survey software does not retain any information about you as an individual

- Score \_\_\_\_\_
- Prefer not to answer

21. What is your affirmed gender?

- Man
- Woman
- Other \_\_\_\_\_
- Prefer not to answer

22. How old are you?

- Age in years \_\_\_\_\_

23. What year of Medical School are you?

- First year
- Second year
- Third year
- Fourth year
- Fifth year - schools outside the US
- Sixth year -schools outside the US

24. What specialty are you pursuing?

- Internal Medicine
- Pediatrics
- OBGYN
- General Surgery
- Neurology
- Psychiatry
- Family Medicine
- Other \_\_\_\_\_
- Not decided

25. What is the most common teaching method used in your School?

- Lecture
- PBL - Problem Based Learning
- TBL - Team Based Learning
- CBCL - Case-Based Collaborative Learning
- Other \_\_\_\_\_

#### Appendix 4. Faculty survey questionnaire

1. Do you discuss study techniques in class?

- Yes
- No

*Display This Question:*

*If Do you discuss study techniques in class? = Yes*

2. How often do you discuss study techniques?

- A few times a week
- About once a week
- Before tests/major assignments
- About once every semester
- Other \_\_\_\_\_

3. How do you think your students **choose** to study?

- Whatever's due soonest/overdue
- Whatever they haven't studied for the longest time
- Whatever they find interesting
- Whatever they feel they're doing the worst in
- They plan their study schedule ahead of time and they study whatever they have scheduled

4. How do you think your students **should** choose to study?

- Whatever's due soonest/overdue
- Whatever they haven't studied for the longest time
- Whatever they find interesting
- Whatever they feel they're doing the worst in
- They plan their study schedule ahead of time and they study whatever they have scheduled

5. Do you return to earlier material in later sections? (e.g., reviewing week 1 material near the middle of the semester)

- Yes

No

6. Do you recommend study techniques to students, either in class or during out of class meetings?

Yes

No

7. If yes, which of the following study techniques do **you recommend** students use regularly? (please check off all that apply)

test yourself with questions or practice problems

use flashcards

recopy your notes

reread chapters, articles, notes, etc.

make outlines while reading

underline or highlight while reading

make diagrams, charts, or pictures

study with friends

"cram" lots of information the night before the test

ask questions or verbally participate during class

other (Please describe) \_\_\_\_\_

8. If you do discuss study techniques in class, do you think students use those techniques?

Yes

Yes for my class, but not necessarily for others

No

Some do, some do not

9. If you think students should quiz themselves (either using a quiz at the end of a chapter, a practice quiz, flashcards or something else), why should they do so?



- They will learn more that way than through rereading
- To figure out how well they have learned the information they're studying
- I do not think quizzing will necessarily benefit students

10. Do you use/encourage spacing techniques in class? (e.g., leaving days/weeks for students to study for the next exam or returning to information after discussing it)

- Yes
- No

11. Do you believe students have different learning styles (e.g., visual vs. auditory learners)?

- Yes (1)
- No (2)

*Display This Question:*

*If Do you believe students have different learning styles (e.g., visual vs. auditory learners)? = Yes*

12. Do you teach to accommodate those differences?

- Yes
- No

13. The next section will present pairs of course or study scenarios. You will be asked to rate each scenario. Two assignments ask students to learn the list of cranial nerves using a mnemonic device. **Assignment A** includes a commonly used mnemonic device provided by the instructor to assist students in their learning. **Assignment B** asks students to create their own mnemonic device to assist their learning. After two weeks, all students are asked to list the cranial nerves in order. Please give your rating for **assignment A** for learning cranial nerves

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

14. Please give your rating for **assignment B** for learning cranial nerves

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

15. In two different classes, a 275-word prose passage about pathophysiology is presented. In **Class A**, students first study the passage for seven minutes, and then are asked to write down from memory as much of the material from the passage as they can. In **Class B**, students first study the passage for seven minutes, and then are asked to study the passage again for another seven minutes. After one week, all students are asked to recall as much of the passage as they can remember. Please give your rating for **class A** for recalling the passage after 1 week.

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

16. Please give your rating for **class B** for recalling the passage after 1 week.

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

17. Two professors present 6 slides showing each of 12 tissue types (72 slides total).

**Professor A** presents all six slides of a single tissue (i.e., grouped), and then moves on to the next set of tissues' six slides, and so on, until all slides have been presented.

**Professor B** presents the various tissues' slides in an intermingled fashion (i.e., mixed), such that a single slide of a particular tissue would be followed by a different tissue. Please give your rating for **professor A's** teaching technique

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

18. Please give your rating for **professor B's** teaching technique

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

19. Two students are studying for an exam. **Student A** studies the two days leading up to the exam. **Student B** starts studying two weeks before the exam, studying a little bit everyday. Both students study the same number of hours. Please give your rating for **Student A's** study strategy

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

20. Please give your rating for **Student B's** study strategy

- Very ineffective
- Ineffective
- Somewhat ineffective
- Neither effective nor ineffective
- Somewhat effective
- Effective
- Very effective

21. Which of the study strategies do you think is **most effective** for learning? Please click to move and **rank** from 1-11. 1 as the most effective and 11 as the least effective.

- \_\_\_\_\_ test yourself with questions or practice problems
- \_\_\_\_\_ use flashcards
- \_\_\_\_\_ recopy your notes
- \_\_\_\_\_ reread chapters, articles, notes, etc.
- \_\_\_\_\_ make outlines while reading
- \_\_\_\_\_ underline or highlight while reading
- \_\_\_\_\_ make diagrams, charts, or pictures
- \_\_\_\_\_ study with friends
- \_\_\_\_\_ “cram” lots of information the night before the test
- \_\_\_\_\_ ask questions or verbally participate during class
- \_\_\_\_\_ other (Please describe)

22. How many years have you been teaching?

- Number of years \_\_\_\_\_

23. What subject/area do you teach? If more than one, choose the subject/area you teach in the most

- Pre clinical medical students
- Clinical medical students
- Residency

24. On average how many students do you teach on a regular basis in a classroom or clinical setting each year?

- Number of students \_\_\_\_\_

25. What is your academic rank?

- Professor
- Associate Professor
- Assistant Professor
- Adjunct Professor
- Graduate Teaching Assistant
- Academic Adviser

- Instructor
- Other \_\_\_\_\_

26. Please sum to 100% how do you distribute your working time  
patient care : \_\_\_\_\_  
administrative : \_\_\_\_\_  
clinical research : \_\_\_\_\_  
laboratorial research : \_\_\_\_\_  
teaching : \_\_\_\_\_  
other : \_\_\_\_\_  
Total : \_\_\_\_\_

27. What is the **most** common teaching method used in your School?

- Lecture
- PBL - Problem Based Learning
- TBL - Team Based Learning
- CBCL - Case-Based Collaborative Learning
- Other \_\_\_\_\_

28. What is your affirmed gender?

- Man
- Woman
- Other \_\_\_\_\_
- Prefer not to answer

