

Assessing Awareness and Usage of Evidence-Based Learning Strategies among Undergraduate Medical Students

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Abstract:

Introduction: Awareness and usage of evidence-based learning strategies is important for health professional students to engage in self-regulated lifelong learning. But, most of the students still continue to rely on ineffective study habits.

Methods: Online survey-based assessment of awareness and usage of evidence-based learning strategies among MBBS students in one of the medical colleges in South India (n=661).

Results: Significant number of medical students are still using non-evidence-based learning strategies like rereading underlined or highlighted material (433/661, 65.5%) and underutilizing self-testing as a tool of learning (67/661, 10%). Over 50% of the students believe they have a specific learning style (332/661, 50.2%).

Conclusion: The results of this study when compared to previous studies indicate that though there is increased awareness and usage of some of the evidence-based learning strategies among health professional students, there is still a significant percentage of students who believe and rely on few non-evidence-based learning strategies. Hence, medical educators need to focus on educating the students how to learn and use metacognition in self-regulated lifelong learning.

Keywords: Evidence-Based Learning Strategies, Metacognitive Awareness, MBBS Students.

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Introduction

In the present era of availability of many “Evidence-Based Learning Strategies” [1 & 2], most of the students still continue to rely on ineffective study habits[3]. Lack of awareness and usage of these evidence-based learning strategies is associated with poor academic performance among both high school [4] and college students [5]. Awareness and usage of evidence-based learning strategies is especially important for health professional students to engage in self-regulated lifelong learning [6].

Most of the published studies assessed awareness of effective learning strategies using Metacognitive Awareness of Reading Strategies Inventory [7]. The present study aims at assessing the awareness of effective learning strategies and exploring some of such specific learning techniques which include “Interleaving, Generation, Spacing, and Testing effect” among the MBBS students.

Materials and Methods: The present study is a cross-sectional survey-based study assessing

awareness and usage of evidence-based learning strategies among MBBS students in one of the medical colleges in South India. Google form survey link with appendix A and appendix B was created and shared to all years of undergraduate medical students. Before collecting the responses, students of each year were explained about this study in detail, including the questionnaire, response options and Likert rating scale. All the responses were collected over a period of one month (April 2024).

Usage of evidence-based learning strategies was measured using individual survey items (Question Nos. 1-8 of appendix A). Results were compiled in Google response sheet, analyzed and descriptive statistics were presented using proportions.

Awareness of evidence-based learning strategies was measured using one question about learning styles (Question No. 9 of Appendix A) and hypothetical responses to four case scenarios (Appendix B). Students rated two possible study

options for each case scenario on a seven-point Likert scale ranging from 1=very ineffective to 7=very effective. Results were compiled in Microsoft Excel Sheet and analyzed using SPSS software, Version 20.0. Descriptive statistics were presented using proportions and means with standard deviation. t-tests were used to compare the mean rating given to the evidence-based and non-evidence-based responses for each scenario and effect sizes were reported with Cohen's *d*.

Students' responses were coded as '0' if the evidence-based option was given higher rating than non-evidence-based option and '1' if the non-evidence-based option was given higher rating than evidence-based option. Mean percentage of the

students giving higher rating for each of the evidence-based scenario was calculated and tabulated.

Appendix A: Questionnaire developed by cognitive psychologists to assess adherence to evidence-based study strategies among undergraduate college students [2, 5,6]

Appendix B: Learning case scenarios (Generation, Retrieval, Interleaving & Spacing) developed by Piza F et al were used by doing minor modifications [7]

Ethical approval for this study was provided by Institutional Ethics Committee under protocol number 129/SRC/2024.

Appendix A: Students' responses to a survey of study habits

1. Would you say that you study the way you do because a teacher (teachers) taught you to study that way?
<ul style="list-style-type: none"> • Yes • No
2. How do you decide what to study next?
<ul style="list-style-type: none"> • 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?
<ul style="list-style-type: none"> • Yes • No
4. When you study do you typically read a text book/ article/other source material more than once?
<ul style="list-style-type: none"> • 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?
<ul style="list-style-type: none"> • 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?
<ul style="list-style-type: none"> • 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?
<ul style="list-style-type: none"> • 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.)
<ul style="list-style-type: none"> • 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 a visual, auditory, verbal or kinesthetic

learner)?

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

Appendix B: Learning case scenarios

1. Two assignments ask students to learn the role of iodine in the synthesis of thyroid hormones. Assignment A includes a notes provided by the instructor to assist students in their learning. Assignment B asks students to create their own notes to assist their learning. After two weeks, all students are asked to write a slip test.

1A. Please give your rating for assignment A for learning the role of iodine in the synthesis of thyroid hormones.

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

1B. Please give your rating for assignment B for learning the role of iodine in the synthesis of thyroid hormones.

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

Appendix B: Learning case scenarios

2. In two different classes, a 275-word passage about physiology of muscle contraction 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.

2A. 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

2B. 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

Appendix B: Learning case scenarios

3. Two professors discuss the three different aspects of muscles in the anterior compartment of the thigh (Quadriceps, Pectineus and Sartorius). These aspects include: 1. Attachments 2. Nerve Supply and 3. Blood Supply

Professor A discusses all the muscles attachments followed by blood supply for all the muscles and nerve supply for these muscles.

Professor B discusses each muscle at a time with its attachments, nerve supply and blood supply followed by three different aspects of the other two muscles in a similar fashion.

3A. Please give your rating for professor A's teaching technique

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

3B. Please give your rating for professor B's teaching technique

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

Appendix B: Learning case scenarios

4. 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 every day. Both students study the same number of hours.

4A. Please give your rating for Student A's study strategy

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

4B. Please give your rating for Student B's study strategy

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

- Effective
- Very effective

Results:

Characteristics of participants

Google form survey link was sent to 800 MBBS students.

The number of students who gave consent and completed the survey were 661 i.e., the overall survey response rate was 82.6%. Among them 54.5% (n=360) were females and 45.5% (n=301) were males. Maximum number of students responded for the survey was from the 2nd year.

Table 1: Characteristics of students' participants in a survey of awareness and usage of effective learning strategies

Students' variables	N (%)
Gender	
• Men	301 (45.5%)
• Women	360 (54.5%)
• N total	661 (100%)
Year of Medical College	
• 1 st	157 (23.7%)
• 2 nd	207 (31.3%)
• 3 rd	178 (26.9%)
• 4 th	119 (18%)
• N total	661 (100%)

Note: N: Number; %: Percentage.

Awareness and usage of evidence-based learning strategies among medical students

Survey responses revealed that majority of the students' (450/661, 68%) study methods were not influenced by their teachers (Question No. 1). However, nearly 32% (211/661) of students reported using a strategy suggested by a teacher. When deciding what to study next (Question No. 2), most of the students preferred to study whatever they find interesting (276/661, 40%). Only 18% (118/661) of the students plan their study schedule in advance. Though many students (390/661, 59%) reported that they do return to the course material for review (Question 3) after a course has ended, 41% (271/661) of students are still not returning to course material once a course has ended. Only 10% (67/661) of the students reported usage of quizzing (Question No. 5) because they learned more that way than through rereading. But over half of the students (366/661, 55.4%) reported its usage as a metacognitive tool to figure out how well they have

learned the information and not as a means to boost their performance. This reflects their lack of awareness of the testing effect.

Though significant number of students used different evidence-based learning strategies (Question No. 8) like testing (202/661 30.6%), making diagrams, charts, or pictures (298/661, 45%) and studying with friends (290/661, 43.9%), many students still reported using non-evidence-based study techniques such as rereading (300/661, 45.4%), making outlines (274/661, 41.5%), highlighting (458/661 (69%) and cramming (157/661, 23.8%). Strategies like using flashcards (60/661, 9%), asking questions and verbally participating during class (46/661, 7%) were less endorsed by the students. In addition, 3.4% (26/661) of the students mentioned web-based learning as a study strategy. Lastly, over 50% of students believed that they have a specific learning style.

Table 2: Students' study survey responses

Questions	Choices	N/N total (%)
1. Would you say that you study the way you do because a teacher (teachers) taught you to study that way?	Yes	211/661 (31.9%)
	No	450/661 (68.1%)

2. How do you decide what to study next?	1. Whatever is due soonest/overdue	128/661 (19.4%)
	2. Whatever I haven't studied for the longest time	58/661 (8.8%)
	3. Whatever I find interesting	276/661 (40.4%)
	4. Whatever I feel I'm doing the worst in	90/661 (13.6%)
	5. I plan my study schedule ahead of time, and I study whatever I've scheduled	118/661 (17.9%)
3. Do you usually return to course material to review it after a course has ended?	Yes	390/661 (59%)
	No	271/661 (41%)
4. When you study, do you typically read a text book or article or other source material more than once?	1. Yes, I reread whole chapters/articles	142/661 (21.5%)
	2. Yes, I reread sections that I underlined/highlighted/marked	433/661 (65.5%)
	3. Not usually	86/661 (13%)
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?	1. I learn more that way than I would through rereading	67/661 (10.1%)
	2. To figure out how well I have learned the information I'm studying	366/661 (55.4%)
	3. I find quizzing more enjoyable than rereading	66/661 (10%)
	4. I usually do not quiz myself	162/661 (24.5%)
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?	1. Make sure to study (or test yourself on) it again later	416/661 (62.9%)
	2. Put it aside and focus on other material	245/661 (37.1%)
7. Which of the following best describes your pattern of study?	1. I most often space out my study sessions over multiple days/weeks	357/661 (54%)
	2. I most often do my studying in one session before the test	304/661 (46%)
8. Which of the following study strategies do you use regularly? (Please check off all that apply.)	1. Test yourself with questions or practice problems	202/661 (30.6%)
	2. Use flashcards	60/661 (9.1%)
	3. Recopy your notes	144/661 (21.8%)
	4. Reread chapters, articles, notes, etc.	300/661 (45.4%)
	5. Make outlines while reading	274/661 (41.5%)
	6. Underline or highlight while reading	458/661 (69.3%)
	7. Make diagrams, charts, or pictures	298/661 (45.2%)
	8. Study with friends	290/661 (43.9%)
	9. 'Cram' lots of information the night before the test	157/661 (23.8%)
	10. Ask questions or verbally participate during class	46/661 (7%)
	11. Others (Please describe)	26/661 (3.4%)
9. Do you believe you have a specific learning style (e.g. are you visual or verbal or auditory or kinesthetic learner)?	Yes	332/661 (50.2%)
	No	57/661 (8.6%)
	3. No, I learn best through multiple methods	272/661 (41.1%)

Note: N: Number; %: Percentage.

Students' rating of evidence and non-evidence-based case scenarios

Students gave a higher rating to the evidence-based options than the non-evidence based options in all the four case scenarios (Generation, retrieval, interleaving and spacing). Statistical comparison was done with paired sample t- test between the two options for each scenario and the resulting effect size.

All the scenarios yielded a higher rating for the evidence-based option relative to the non-evidence-based option, but large effect size ($d=1.01$) was found only in spacing scenario. In the remaining 3 case scenarios no reliable difference in ratings (Retrieval) or a marginal difference in rating (Generation & Interleaving) were seen. Statistically significant difference ($P<0.001$) was found among the students regarding the evidence based and non-evidence based strategies in the three case scenarios (Generation, interleaving and spacing).

No statistical significance ($P=0.25$) was identified between evidence based and non-evidence based

options in retrieval vs rereading case scenario.

Table 3: Students' mean ratings and standard deviations for evidence-based (EB) and non-evidence based (Non-EB) options for the learning scenario questions

Scenario	EB option		Non-EB option		Comparison	
	M	SD	M	SD	T	Cohen'sd
Students' responses						
• Generation	5.9	1.39	5.04	1.36	- 11.44	0.63
• Retrieval	4.9	1.58	4.8	1.62	- 1.14	0.06
• Interleaving	5.57	1.37	4.65	1.64	- 10.98	0.59
• Spacing	5.79	1.23	4.32	1.71	- 17.98	1.01

Note: M: Mean; SD: Standard Deviation; T: Paired samples t-test comparing ratings to each option for each scenario. Cohen's d: Effect size comparing responses to the EB option and non- EB option.

Mean percentage of students providing higher rating for the evidence-based scenarios

Majority of the students assigned a higher rating to the evidence-based option in the generation, interleaving and spacing case scenarios.

Whereas in retrieval vs rereading case scenario, students assigned nearly equal rating to both the evidence-based and non-evidence-based options.

Table 4: Mean percentage of students providing higher rating for the EB scenarios.

Scenario	Percentage of Students
Generating	429 (65%)
Retrieval	290 (43.9%)
Interleaving	396 (60%)
Spacing	453 (68.5%)

Discussion:

In this study conducted in one of the medical institutes in south India, we found that many medical students are aware and used some of the evidence-based learning strategies but still significant percentage of students followed non-evidence-based learning strategies. In our study more number of students (211/661, 32%) reported that they followed the learning strategies suggested by a teacher (teachers) compared to the study done by Piza F et al. 2019. Around 68% (450/661) of students improvised their method of studying. Presuming that the teachers are aware of the evidence-based learning strategies, the students who improvised their method of studying (450/661, 68%) might be vulnerable to the pitfalls of self-regulated study if they are unaware about evidence-based learning strategies.

When compared to previous studies (Kornell and Bjork 2007; Hartwig and Dunlosky 2012; Morehead et al. 2016; Piza F et al. 2019) in our study in response to the question: how do you decide what to study next? 40.4% (276/661) of the students chose "Whatever I find interesting" and only 17.9% (118/661) of students plan the study schedule ahead of time, and study whatever scheduled. This emphasize that they have motivation for learning but unable to prioritize the activities conducive to long-term learning.

In a response to the question regarding self-testing only 10.1% (67/661) of the students thought of self-testing as a learning tool. This implies their lack of awareness about self-testing as tool for learning. In contrast to study by Kornell and Bjork 2007, majority of the students (416/661, 62.9%) make sure to study the question again later even when they become convinced that they know the answer to a certain question.

In our study on health professional students, similar to Piza F et al. 2019 reported greater use of spacing technique (357/661, 54%) when compared to college students, however, 46% (304/661) still rely on cramming technique for tests. Similar to Piza F et al. 2019 and in contrast to Morehead et al. 2016 & Hartwig et al. 2012 making diagrams pictures and charts is more popular and usage of flashcards is less popular. 43.9% (290/661) of students in our study responded that they discussed subject matter with friends which improve learning. This is similar to most of the studies. Over 50% (332/661) of undergraduate medical students still believed that they have a specific learning style which according to many researches is a myth. Hence there is a strong need to debunk this myth of specific learning styles among the students by educators. Dual-coding theory is an option for reframing learning style theories within a more evidence-based approach (Sadoski and Paivio 2012) for educators.

Limitations: Our study has many limitations. This study is confined only to the undergraduate medical students of a single medical college and hence it may not reflect the opinion of all health professional students. Moreover, students' responses are self-reported and thus may not reflect their true study practices. We did not explore other evidence-based learning strategies like elaboration, dual coding and using concrete examples.

Future research

Faculty also need to be evaluated for the awareness of evidence-based learning strategies as it is important to identify the blind spots in teaching skills and to know the extent of knowledge gap. Enhancing the faculty's knowledge of these strategies by including them into faculty development programs in medical education plays a crucial role in optimizing students' learning by teaching the students how to learn.

Conclusion

Lack of metacognitive awareness and usage of several evidence-based learning strategies among undergraduate medical students' stress the need for formal training about such strategies. Incorporating evidence-based learning strategies into the learning environment of medical students can significantly enhance their learning outcomes which may ultimately minimize medical errors.

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