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ORIGINAL RESEARCH

Self-reported Learning and Study Strategies in First and Second Year Medical Students

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Abstract

Medical school presents a unique challenge to the average learner as the instructional strategies used in medical curricula are often different than what the student has experienced prior. The large volume of information taught in medical school is delivered with a variety of techniques. After the educational material has been delivered, it is the student's responsibility to study and learn the information for future exams and for their future patients. The current study aims to explore what learning activities and teaching strategies first (M1) and second year (M2) medical students use and prefer. Additionally, the study aims to determine if there are cohort differences in classroom and study habits. A group of 95 M1 students and 109 M2 students were recruited to participate in this online survey study. The analyses indicated statistical differences between M1 and M2 student cohorts with M1 students preferring group work and small group discussions more than M2 students. Classic didactic lecturing was preferred by 71.6% of students surveyed. M1 students reported a greater tendency for self-testing and group study versus M2 students. GPA and study technique preference were not correlated. These findings indicate that medical students are not using research-based learning and study strategies at the possible detriment of long-term knowledge retention. Modeling of research-based learning and study strategies by medical educators is one possible solution to encourage medical students to change their study practice. Future work should focus on how medical student learning preferences change as they progress through medical school.

Keywords Medical education · Learning · Instruction · Studying · Testing effect

Introduction

Medical school requires a fundamental shift in learning for most students. Curricula, classroom instruction, and instructional strategies likely differ in medical school from what students were expecting or were used to in prior schooling. Many students struggle with the shift to less didactic instructional methods, the large volume of information, and more frequent high-stakes examinations [1]. Students must make substantial lifestyle changes to cope with the demanding nature of medical school [2]. Time that might have been spent on socializing or engaging in hobbies turns into time needed to study. In a recent study exploring how much time students spend engaging in academic activities, students logged spending 7.8 h on average per weekday in academic-related endeavors with 3 h spent in class and 3.8 h on average dedicated to studying outside of class and 4.9 h on average per weekend [3]. Classroom instruction is a key aspect of their academic activities. What students prefer and how that aligns with best teaching practices has been explored. However, reported preference findings have been conflicting [4, 5]. Additionally, it is important to identify what strategies medical students are using when they are studying and whether these strategies align with established evidence-based practice and learning theory.

Research at the intersection of education and cognitive psychology has informed the most effective ways to learn and retain information. Self-testing or retrieval practice, interleaving or intertwining different topics instead of studying materials in a blocked order, and distributed or spaced practice over time have shown to enhance long-term retention of material [6–8]. However, students do not

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always endorse these strategies when asked to report what specific strategies they use [9–11]. Studies of medical students engaging in these strategies have shown better retention of material and transfer of information [8, 12–17]. More specifically, distributed practice and retrieval practice have been shown to improve retention of anatomy information [14] and interleaving [16] and retrieval practice [13] have been shown to improve retention of physiology information. Retrieval practice has also shown to improve performance on standardized patient testing and clinical topics for first year students [8] and residents [15] as well as high-stakes board examinations [18, 19]. Retention of material is essential to a medical student's success in clinical rotations, residency, and future practice. When studying, medical students must first determine what information and resource type to use before they engage with the material. Secondly, they then decide how to go about studying to learn the material for the immediate test and to commit the material to long-term memory. Both components can be influenced by medical educators.

The classroom serves as a platform for students to understand what and how they should be studying. To aid students in the development of these skills, medical educators seek to use teaching techniques grounded in learning theory to enhance student learning outcomes. Some of the best teaching practices to achieve this are outlined in several reviews [20–22]. Recommendations include incorporating interactive and experiential learning in the classroom, providing extensive and explicit feedback, providing specific instructions on coursework, providing frequent opportunities to assess student knowledge, and utilizing technology for course content and self-directed learning as well as virtual study aids and environments (e.g., apps and social media). Interestingly, students do not always prefer these more active learning strategies. A study aimed at identifying year 1 and 2 medical students' classroom activity preferences found that 72% of the sample preferred lectures. This preference was similar across cohorts and gender [4]. When students were asked to report problems with lectures, they reported non-interactive lectures as a key issue, along with the difficulty of the topic, and their own disposition in the classroom (e.g., inability to focus, sleepiness). In a more recent study on medical students' preferred teaching methods, 81.3% of medical students survey reported a preference for practical demonstrations, whereas only 63.8% reported a preference for more traditional lecturing methods [5]. These findings were interpreted by the researchers to indicate a shift in student preferences towards more active learning.

With medical students increasingly moving to an online academic experience even prior to the global pandemic, it is imperative to explore how they approach the academic environment as they transition through medical school. Evaluating their approaches to studying and preferred learning methods may lead to new insights into teaching, mentoring, and identifying and providing needed resources for medical students.

The primary aim of the present study is to explore what learning activities and teaching strategies medical students use and prefer. Additionally, the study aims to determine if there are cohort differences in classroom and study habits and evaluate if study habits relate to overall academic achievement.

Method

Participants

First (M1) and second year (M2) medical students ($N = 204$; approximately 56% female and 70% white) with an average age of 25 were recruited through internal student email distributions lists. The medical students recruited for this study were current medical students at Kansas City University (KCU) which includes two campuses, Kansas City and Joplin. Participants were split into two cohorts for analysis, M1 ($N = 95$) and M2 ($N = 109$). There are approximately 400 medical students per cohort across the two campuses. The response rates for M1 and M2 were approximately 24% and 27%, respectively. There were no statistical differences in self-reported GPA between cohorts (Overall: $M = 3.18$, $SD = 0.48$, $N = 179$).

Procedure

Data collection as part of an institutional review board–approved study on the characteristics of medical and professional students occurred in the middle of the fall 2018 semester. An email with an online link to several affective and personality measures was sent to all students. Due to the low response rate of other programs (Doctorate of Psychology and Master's in Biosciences) and year 3 and 4 students on clinical rotations, only M1 and M2 student data was analyzed. Furthermore, since the majority of lectures are presented in the first two years of the medical school curriculum, the studying and lecture-based questions outlined in the measures were most appropriate for these cohorts. The focus of the current paper is on a subset of questions regarding classroom and studying habits. Participants were asked, "What type of learning activities do you prefer in the classroom?" and "How do you typically study?" Response options were presented for each of these prompts, and participants were asked to choose all that apply (see Tables 1 and 2). The classroom response options were created through feedback from students and medical educators and a review of medical education literature. Since students may not know the terms for some classroom activities (e.g., problem-based learning, think-pair-share, and jigsaw

Table 1 Student classroom activity preferences

Activity type	Overall Percent endorsing activity	M1 ($N=95$) Percent endorsing activity	M2 ($N=109$) Percent endorsing activity
Case studies	77.5% (158)	73.7% (70)	80.7% (88)
Classic lectures	71.6% (146)	73.7% (70)	69.7% (76)
Lectures that incorporate technology (e.g., iClickers, TED talks)	61.8% (126)	58.9% (56)	64.2% (70)
Demonstrations	60.3% (123)	57.9% (55)	62.4% (68)
Small group discussions	43.6% (89)	**52.6% (50)**	**35.8% (39)**
Activities that make you think about how you are learning (e.g., activities that make you self-reflect or those in which you are given feedback)	27.9% (57)	25.3% (24)	30.3% (33)
Group work (e.g., generating test questions, coming up with a solution to a problem or answering questions)	27.5% (56)	**36.8% (35)**	**19.3% (21)**
Collaborative note-taking (e.g., comparing notes with others or creating a living document with other students to integrate notes)	21.6% (44)	24.2% (23)	19.3% (21)
Debates	12.7% (26)	11.6% (11)	13.8% (15)
Large group discussions	5.4% (11)	3.2% (3)	7.3% (8)
Other comments		"Hands-on labs" "Laboratory (dissections, OM, etc.) physical representation"	"Self-study" "Q and A" "Board relevant material. Group projects and group discussions are an inefficient usage of time." "I learn the best doing practice questions and working on my decision-making in the context of the material. Reading the rationales further impacts my understanding why I need to know something in the clinical sense."

$N=204$. Raw numbers of medical students are in parentheses; bolded activities represent statistically significant ($p<.05$) M1 and M2 differences

activities), response options were described more generally. For the studying response options, a series of modified options from Karpicke, Butler, and Roediger's 2009 study were presented [11]. Undergraduate students in the Karpicke and colleagues' study were asked to list their study strategies and the researchers then rated and reported on the most commonly occurring strategies. These strategies are theorized to be similarly used by medical students as their study strategy use may be carried over to medical school. However, some of these strategies were vague, for example, "memorize" and "think of real life examples" and therefore were removed from the response options for the current study. An additional response option (i.e., re-watching lectures) was added based on feedback from medical educators. Participants were also asked to identify the number one strategy they use to study. Participants also completed several demographic questions (e.g., age, race, year in program, GPA, specialty interest, and reason for choosing that specialty). Following the completion of the survey, participants were given the opportunity to be entered in a raffle for one of ten $50 visa gift cards. The recruitment email was sent out three separate times in the Fall semester separated by two weeks each.

Results

Classroom Preferences

Descriptive statistics for student preferences for classroom instruction overall and by cohort are presented in Table 1. The most frequently endorsed classroom activities for both M1 and M2 students were case studies, classic lectures, lectures incorporating technology, and demonstrations. To determine differences in classroom activity preferences by cohort, chi-square tests of independence were conducted. The cohorts differed in their preference for group work [$\chi^2(1,204)=7.87$, $p<0.01$] and small group discussions [$\chi^2(1,204)=5.86$, $p<0.05$]. The data revealed that 36.8% of M1 students reported a preference for group work compared to only 19.3% of M2 students. Similarly, 52.6% of M1

Table 2 Student studying preferences

Studying type	Overall		M1 ($N=95$)		M2 ($N=109$)	
	Percent endorsing study technique	Percent who rank as #1 strategy	Percent endorsing study technique	Percent who rank as #1 strategy	Percent endorsing study technique	Percent who rank as #1 strategy
Doing practice problems	89.2% (182)	15.2% (31)	87.4% (83)	14.7% (14)	90.8% (99)	15.6% (17)
Re-reading notes or the textbook	72.1% (147)	22.5% (46)	70.5% (67)	16.8% (16)	73.4% (80)	27.5% (30)
Practice recalling information (self-testing)	70.1% (143)	11.8% (24)	76.8% (73)	**18.9% (18)**	64.2% (70)	**5.5% (6)**
Mnemonics (acronyms, rhymes, etc.)	61.8% (126)	1.5% (3)	57.9% (55)	1.1% (1)	65.1% (71)	1.8% (2)
Flashcards	53.9% (110)	13.7% (28)	**63.2% (60)**	10.5% (10)	**45.9% (50)**	16.5% (18)
Make outlines or review sheets	52.5% (107)	17.6% (36)	57.9% (55)	15.8% (15)	47.7% (52)	19.3% (21)
Rewrite notes	47.1% (96)	11.3% (23)	**56.8% (54)**	13.7% (13)	**38.5% (42)**	9.2% (10)
Study with a group	39.2% (80)	3.4% (7)	46.3% (44)	**6.3% (6)**	33% (36)	**0.9% (1)**
By re-watching lectures	32.4% (66)	1.5% (3)	29.5% (28)	1.1% (1)	34.9% (38)	1.8% (2)
Other comments		1.5% (3)	"Videos" "Drawing and modeling (doing the motions myself)"	1.1% (1)	"Board prep material (First Aid, USMLE Rx, Kaplan, Osmosis, Anki Flashcards" "Go over multiple resources of the same topic."	1.8% (2)

$N=204$. Raw numbers of students are in parentheses; bolded strategies represent statistically significant ($p<.05$) M1 and M2 differences

students reported a preference for small group discussions compared to only 35.8% of M2 students.

Studying Preferences

Descriptive statistics for study preferences overall and by cohort are presented in Table 2. For the overall sample, the most frequently endorsed study strategies were doing practice problems, re-reading notes or the textbook, practicing recalling information, and mnemonics. Chi-square tests of independence were run to determine cohort differences in endorsement of study strategies. M1 and M2 students statistically differed in utilization of flashcards [$\chi^2(1,204)=6.11$, $p<0.05$] and rewriting notes [$\chi^2(1,204)=6.83$, $p<0.01$]. First year students reported more flashcard usage (63.2%) and rewriting notes (56.8%) than second year students (45.9% and 38.5%, respectively). The average number of strategies reported by the overall sample was 5.18 ($SD=1.76$). An independent samples t-test indicated that M1 and M2 students statistically differed in the number of strategies they endorsed [$t(202)=2.16$, $p<0.05$, $d=0.30$]. First year students utilized slightly more strategies on average ($M=5.46$, $SD=1.75$) than the second year students ($M=4.94$, $SD=1.74$).

Students were asked to identify the number one way in which they study after being given the chance to choose all study strategies that applied to them. The most commonly endorsed number one study strategy used by the M1 and M2 students was re-reading notes or the textbook (22.5%) followed by making outlines or review sheets (17.6%) and doing practice problems (15.2%). To determine differences in number one study strategy by cohort, chi-square tests of independence were conducted. M1 and M2 students statistically differed in reporting self-testing [$\chi^2(1,204)=8.84$, $p<0.01$] and studying in a group [$\chi^2(1,204)=4.46$, $p<0.05$] as their number one study strategy. First year students (18.9%) more frequently reported self-testing as their number one study strategy compared to second year students (5.5%). Similarly, first year students (6.3%) also more frequently endorsed studying in a group as their number one strategy compared to second year students (0.9%). As an exploratory analysis, relationships between study preferences and self-reported GPA were also explored. No statistically significant relationships were found.

Discussion

The classroom preference results show that students prefer case studies, classic lectures, and lectures that incorporate technology. Reviews written on how to approach teaching students have focused on their observed preferences for interactive and experiential learning in the classroom [20–22]. Our results support that assertion to some extent (e.g., case studies and demonstrations), but also provide evidence that students want to be given the information in the traditional format through classic lectures similar to the results found by Ismail and colleagues [4]. Lectures are an effective way for students to gauge what material is important. However, meta-analytic research findings have shown lower exam performance and higher failing rates in traditional lecture courses compared to courses that incorporated active learning strategies [23]. Students may prefer classic lectures because of the amount of material that is covered and the passive, less effortful nature of the activity. This is contrasted with case studies which were the most endorsed activity (77.5%). Students may prefer case studies because of their applied nature. Lectures serve the purpose of acquiring the necessary basic concepts and case studies may help them to integrate, apply, and test their knowledge of a topic.

Since they have access to an immense amount of material through online resources, medical students may feel that working independently and not being in the classroom is the most effective use of their time. This is supported by the cohort differences in classroom preferences and declines in-class attendance [24]. Compared to first year students, second year students reported less of a preference for group work and small class discussions. One second year student described group work and discussions as "an inefficient waste of time." As students progress through medical school, they are confronted with the realities of the amount and complexity of material they are required to understand, additional academic activities, and the consequences of performance on high-stakes exams.

This may lead to a shift in emphasis in group work expressed by spending less time engaging with other students. Case studies and group work focused on more dynamic and realistic clinical activities (e.g., standardized patients, simulations) that allow them to feel that they are applying and testing their knowledge might be a way to get all students involved with each other. These additional activities may also serve to encourage self-testing or retrieval practice by interleaving or intertwining different topics together.

Study preference findings were similar to previous studies indicating that students use deep approaches or active strategies when studying [25, 26]. Students seem to be aware of active strategies and deep approaches to learning material. However, when they were asked to report their primary study strategy, they did not report utilizing methods found to be the most effective such as self-testing or mnemonics [12–15, 27, 28]. An example of this phenomenon is that 61.8% of students endorse mnemonics as an important study technique but only 1.5% of students rated it as their number one study strategy. Students may not be using study techniques found to be most effective because they are using massed practice (i.e., cramming) which can have short-term performance pay offs [29] at the expense of long-term knowledge retention. They may also have a difficult time figuring out what to study in the first place. Medical students have access to numerous resources. Figuring out what resources to work from may be a contributing factor to the highest rated primary study strategies of re-reading information and making outlines or review sheets. Additionally, they may feel as if they need to cover every possible piece of information at the expense of more effective studying strategies or judge those methods as ineffective for them [9–11]. The amount of material and instructor recommendations for studying may also play a role in the frequently endorsed items of doing practice problems and re-reading notes or the textbook. Interestingly, re-watching lectures was the least endorsed studying method which is similar in nature to re-reading course material. It is possible that students view this activity as more of a classroom type activity versus a studying strategy.

Cohort differences in study strategies emerged not only in the number of strategies endorsed, but also in the types of strategies endorsed. The second year cohort reported using less strategies overall compared to the first year cohort. The strategies that second year students reported using fewer strategies overall compared to the first year cohort. The strategies that second year students reported less frequently included the use of flashcards and rewriting notes. Both of these activities are time-intensive and may not be conducive to the nature of the curriculum in the second year. Second year curriculum at KCU at the time of the study focused heavily on integrating clinical science with pharmacology and pathology. Furthermore, the use of self-testing as the number one study strategy was significantly less reported in the second year cohort compared to that in the first year cohort. This could be due to the shift in curriculum from more basic knowledge in the first year to integration of information in the second year. This finding may also speak to a lack of opportunity for self-testing in the second year. The sheer volume of information could reduce available time to study which could shift study techniques to organizing and summarizing versus spending the time to actively engaging with the material to improve long-term retention.

Collaborative studying opportunities were less endorsed overall and preferred less as the number one study strategy in the second year cohort which may be explained by limited time to study and the shift in the second year for board preparation.

Limitations

Limited context was provided to the research participants for the studying or classroom activities. For example, we did not ask about anatomy versus basic sciences, national licensing exam-specific study strategies, etc. This could have provided a more contextualized picture of classroom and studying preferences. Due to the nature of the studying preference answer choices, we were unable to capture any unique or integrated study methods medical students may use. For example, it is unknown if students engaged in distributed practice or interleaving of materials. Although we provided an "other" option for students to report their study preferences, they did not elaborate on specific strategies beyond board preparation and internet resources (i.e., YouTube videos). As students progress through medical school, they may shift their strategies not only depending on the topic, but also on what has worked for them in medical school. Future studies should evaluate how medical students change, shift, and think about their studying strategies as they develop as medical students. Lastly, study strategies and GPA were not related. Additional analysis in future studies is needed to determine if there is a link between these two variables. This may be due to the general, uncontextualized nature of our questions or the fact that students self-reported their own GPAs.

Conclusions

The current findings demonstrate that students prefer classroom experiences that directly convey information through lectures, but also appreciate hands-on relevant activities such as case studies and demonstrations. In this way, students are actively looking for what they need to know and how to apply that knowledge. Classroom preferences may shift from the first to the second year of medical school with the magnitude of the material and preparation for high-stakes examinations leading to limited time for study. Similarly, students decrease the use of time-intensive study strategies in the second year and report less active strategies such as self-testing as their number one way to study. This could be due to the integrative nature of the material in the second year or the lack of time to engage with effortful study. Self-testing continues to be one of the best ways to recall information and leads to success on national licensing exams particularly when spaced over time [18]. How medical students approach learning material and develop life-long learning skills are key aspects contributing to successful pursuits in medical school and beyond. Medical educators need to be cognizant of the science of learning [6, 7, 28, 30, 31] and aim to deliberately design learning environments to promote active learning and to model effective study strategies.

Author Contribution Study conception and design, material preparation, and data collection and analysis were performed by Marissa Roffler. Substantial contributions to the analysis and interpretation of the data were made by Ryan Sheehy. The first draft of the manuscript was written by Marissa Roffler, and Ryan Sheehy commented, edited, and made substantial contributions to previous versions of the manuscript. All authors read and approved the final manuscript.

Availability of Data and Material The dataset generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code Availability Not applicable.

Declarations

Ethics Approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Institutional Review Board of Kansas City University under 45 CFR 46.101-Exempt Category b-2 (July 11, 2018, No. 1240094–1).

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Consent for Publication Not applicable.

Competing Interests The authors declare no competing interests.

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