ORIGINAL RESEARCH

The Adaptive Learner: How Faculty and Medical Students' Perceptions of Learning Needs and Desires Differ

Crystal J. Graff, MD; Kristina Kaljo, PhD; Robert W. Treat, PhD; Kate Dielentheis, MD

ABSTRACT

Problem Considered: Medical schools historically have utilized instructor-centered lectures to teach medical students the basic sciences. Several commercial electronic-based resources are now available to enhance lecture-based content. This study examines perceptions between students and faculty regarding the efficacy of lecture-based teaching and learning strategies used by students overall.

Research Methods: The authors distributed surveys to medical students and basic science teaching faculty at the Medical College of Wisconsin. Survey items used categorical and 10-point scales and open-ended text response. Mean scores were compared with independent t tests and Cohen d effect sizes. Pearson (r) and Spearman rho (ρ) correlations were used for relational analysis. IBM SPSS 24.0 was used for statistical analysis, NVivo 11 was used for qualitative analysis.

Results: Faculty's perception of meeting students' learning needs was rated significantly higher (mean [SD] = 7.3 [1.3]) than students (5.9 [2.0]) (Cohen d = 1.0/P < .001). There was a significant negative correlation between lectures meeting students' learning needs and time students spent outside of lecture seeking supplemental learning resources (ρ = -0.4/P < .001). Students highlighted their use of personal learning strategies, desire for equitable access to resources, and preparation for national board examinations. Faculty emphasized their perceptions of learning resources, recognition of learning styles, time restrictions, and desire to utilize diverse teaching methods.

Conclusions: Student and faculty perceptions regarding student learning needs were significantly different. Students use lectures extensively, but additionally add to the financial burden of medical school by personally funding supplemental resources. This study helps bridge the gap between medical students and faculty regarding what educational tools are best suited to support a student population with increasingly diverse learning needs.

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INTRODUCTION

A significant challenge facing the advancement of medical education is the ability to provide an optimal learning environment that addresses the individualized needs of medical students. Since the advent of the Flexner report in 1910, the first 2 years of medical school have classically utilized instructor-centered didactic lectures as the primary modality for presenting basic science content.[1] According to the Association of American Medical Colleges (AAMC) Curriculum Inventory, in the 2018-2019 academic year, the majority of medical schools continued to utilize didactic lectures as their primary source of disseminating material.[2] Nonetheless, fewer than half of medical students report attending lecture "most of the time" or "often."[3] Reasons for forgoing lecture attendance include inability to concentrate for long periods of time and low quality of lectures, as well as time saved and flexibility afforded from watching recorded lectures despite no drop in— or even improvement—in performance on exams.[4-6]

Present-day medical students expect to be heavily engaged by learning material as a result of having technology integrated into nearly every aspect of their lives since birth.[7,8] Students' enjoyment and comprehension of material is enhanced by interactive, multimedia education that incorporates multiple learning modalities.[9-11] The integration of faculty-made technological resources, to be used outside the traditional lecture setting, has been described as highly favored by med-

ical students.[12-14] The prevailing reasons that students prefer these supplemental tools include access to up-to-date information, ease of usability, increased flexibility, improved gratification, and personalization of their learning experience.[15-17]

Despite the availability of faculty-made multimedia resources available at some institutions, many students turn to and purchase higher-quality commercial resources that are often not formally provided by medical education institutions.[5,15] Why students seek out these resources has not been extensively studied, although many hypothesize that it is students' familiarity with technology, in addition to utilization of commercial resources to study for the United States Medical Licensing Examination (USMLE) Step examinations.[18] Another consideration includes the marketing strategy that centralizes on the students' perception regarding a "shortcut to success" and unfounded claims that licensing scores can be purchased.[19] Across the nation, many students begin studying for the Step 1 exam with these commercial resources alongside their preclinical curriculum, thus creating a sort of "self-directed parallel curriculum." The most common reported resources include the USMLE First Aid review book, UWorld question bank, and Pathoma review series.[20] Determining how and which technological resources to use posts a challenge to both educators and learners alike, as there are new and improved modalities developed every day.[8]

Several reported studies have surveyed medical students regarding the relevant medical educational technologies used to study for the USMLE Step 1 examination. To the authors' knowledge, no previous studies have assessed faculty's awareness of these resources or how students utilize them to supplement formal medical school curriculum. The purpose of this study was to analyze perceptions between medical students and faculty regarding the overall efficacy of lecture-based teaching and the corresponding learning strategies that students employ to solidify knowledge. Overall, we sought to evaluate the current educational model in the basic sciences curriculum to determine if it is adequate to meet the needs of present-day medical students.

Table 1. Medical Student Survey

Question	Answer Options
What is your gender?	Male, female, choose not to answer
What is your age?	18-22, 23-27, 28 and above, choose not to answer
During the 2016-2017 academic year, what year in school were you at MCW?	M1, M2, M3, choose not to answer
How do you describe yourself (select all that apply):	White or Caucasian; Black or African American; Asian or Asian American; American Indian or Alaska Native; Hawaiian or Other Pacific Islander; Hispanic or Latino; choose not to answer
I prefer to use lectures as my main source of learning material	Strongly disagree, disagree, neither agree or disagree, agree, strongly agree, not applicable
I attend lecture mainly to absorb as much of the material as possible	
I prefer when lecturers incorporate multiple teaching modalities into their presentations	
I re-watch lectures to review material	
I find that educational resources (other than lecture) often explain material better than lecturers	
I believe that lecturers often relate basic science principles to clinical practice	
In the past academic year, lectures met my learning needs. (Likert scale: 1-10)	(1=not at all, 10=very much)
How often do you spend time seeking out additional educational resources to supplement lectures?	Every day, every other day, once per week, rarely
What, if any of the following resources do you regularly use outside of lectures?	Textbooks, individual tutoring, academic enhancement, public websites, evidence-based journals, Sketchy, First Aid, Pathoma, YouTube, Anki, Draw-it-to-Know It, Firecracker, study groups, premade study charts
What, if any educational resources would you like the school to provide for you?	(free response)
Rank the following learning styles in the order that describes you best. (1=most describes me, 4= least describes me)	Visual, auditory, read/write, kinesthetic
How often do you attend class/lecture in person?	Rarely, 25%-50% of the time, 50%-75% of the time, nearly 100% of the time
If you don't attend class in person, select the choice below that best fits how you listen to lecture the majority of the time	Live-stream lecture, watch lecture recording at normal speed, watch lecture recording at a faster speed
Tell me more about your personal learning and study habits	(free response)

Abbreviations: MCW, Medical College of Wisconsin; M1, first-year medical student; M2, second-year medical student; M3, third-year medical student.

METHODS

In August 2017, medical students and faculty from the Medical College of Wisconsin (MCW) were invited to participate in this study. MCW consists of 1 central campus in Milwaukee, Wisconsin and 2 regional campuses in Green Bay and Wausau, Wisconsin. Course material in the basic science years (first and second years of medical school) are primarily presented by way of didactic lectures, but also includes a limited number of small-group problem-based sessions. Separate and anonymous web-based surveys were developed using Qualtrics for both student and faculty groups. Survey questions were developed by a team

Table 2. Faculty Survey

Question	Answer Options
What is your gender?	Male, female, choose not to answer
What is your age? choose not to answer	29 and below, 30-39, 40-49, 50 and above,
How many years have you taught M1/M2 classes?	1-5, 6-10, 10 and above, choose not to answer
What is your faculty status at MCW? lecturer, choose not to answer	Assistant professor, associate professor, professor,
How do you describe yourself (select all that apply) Asian or Asian American; American Indian or Alaska Native; Hawaiian or Other Pacific Islander; Hispanic or Latino; choose not to answer	White or Caucasian; Black or African American;
I think students use lectures as their primary source of learning material	Strongly disagree, disagree, neither agree or disagree, agree, strongly agree, not applicable
I think that students attend lecture to absorb as much material as possible	
I often incorporate multiple teaching modalities into my lectures	
I feel that my lectures are organized effectively to best support learning	
I often relate basic science principles to clinical practice in my lectures	
I often wish I had more time to present my lecture material to students	
I think students often seek outside resources because lectures are confusing	
I regularly recommend outside resources to supplement lecture material (other than textbooks	
I am aware of and/or think that students regularly use the following outside resources to supplement lectures journals, Sketchy, First Aid, Pathoma, YouTube, Anki, Draw-it-to-Know It, Firecracker, study groups, premade study charts	Textbooks, individual tutoring, academic enhancement, public websites, evidence-based
In the past academic year, I feel that my teaching methods met the learning needs of the students.	Likert scale: 1-10 (1=not at all, 10=very much)
Rank the following learning styles in the order that describes you best. (1=most describes me, 4 = least describes me)	Visual, auditory, read/write, kinesthetic
What learning style do you believe is most common among M1/M2 medical students?	Visual, auditory, read/write, kinesthetic
Tell me more about your teaching style	(free response)

Abbreviations: MCW, Medical College of Wisconsin; M1, first-year medical student; M2, second-year medical student.

of researchers with extensive experience in medical education research. Questions were analyzed individually by each team member and vetted for statistical quality. Utilizing a listserv provided by the school, a 13-item survey (Table 1) was sent via email to current first-year (M1), second-year (M2), and third-year (M3) students at MCW-Milwaukee, Green Bay, and Central Wisconsin. M4 students were not included given their remoteness to the basic science curriculum and concern that recall of their study habits from 2 years prior may not be accurate. An 11-item survey (Table 2) was sent to basic science teaching faculty who teach 1 or more lectures to the M1 and/or M2 students at MCW. Participants were given 2 weeks to complete the survey and received a reminder email 1 week following the initial email.

Survey items used categorical, 10-point scales (10 = high), and open-ended text-response formats. Mean scores were analyzed with independent t tests and Cohen d effect sizes. Median scores were compared with Mann-Whitney U tests. Frequencies and percentages were analysed with Pearson chi-square tests. Spearman rho (ρ) correlations and stepwise multivariate linear regressions were used for relational analysis. IBM SPSS 24.0 was used for statistical analysis.

Two members of the research team (CG and KK) qualitatively analyzed the open-ended text responses. Beginning with open coding, responses were read independently by each reviewer line-by-line, word-by-word and systematically categorized into recurring concepts. Using the constant comparison method, incidents identified by faculty and students were further distilled into cross-cutting themes to address the research question. The MCW Institutional Review Board approved this study.

RESULTS
Quantitative Results
Twenty-two percent (155/711) of students and 22% (81 of 376) of faculty responded to their respective surveys. Table 3 displays the demographics collected on student and faculty participants. Tables 4 and 5 provide descriptive statistical results corresponding to research questions in the student and faculty surveys that are otherwise unmentioned elsewhere due to low effect size. Faculty's perception of meeting students' learning needs via lectures was rated significantly higher (mean [SD] = 7.3 [1.3]) than students (5.9 [2.0]) (Cohen d = 1.0, P < 0.001). No significant difference in learning needs being met by lectures was reported between medical student years (d = 0.4, P < 0.069). Students prefer when lecturers incorporate multiple teaching modalities into their presentations (61%; 96/155). Faculty declared that they often incorporate multiple teaching modalities into their lectures (55%; 45/81). Several students reported attending lectures in person less than 50% of the time (43%; 66/155). Of those students who do not attend class in person, the majority reported watching the lecture recording at a faster speed than normal (63%; 97/155).

Students reported utilizing a significantly higher number of supplemental educational resources (5.9 [2.0]) than faculty (4.7 [2.1]) perceived (Cohen d = 0.6, P < .001). The top 5 resources used by students included SketchyMedical (114/155, 74%), First Aid (99/155, 64%), YouTube (98/155, 63%), Pathoma (84/155, 54%), and Academic Enhancement (MCW's student-led group tutoring program) (80/155, 52%). Faculty perceived that students predominantly used textbooks (63/81, 78%), public websites (55/81, 68%), study groups (55/81, 68%), First Aid (34/81, 42%), and Pre-Made Study Charts (30/81, 37%) to supplement lectures. The Figure portrays the extent to which students reported utilizing these resources versus those that faculty were aware of and/or thought students were using. On the other hand, 70% (78/112) of M1/M2 medical students preferred to use lectures as their main source of learning materials compared to 39% (14/36) of M3 students (P < 0.001). There was a significant negative correlation between meeting learning needs and time spent outside of lecture seeking supplemental learning resources (ρ = -0.4, P < 0.001). Supplemental educational resources often explain material better than lectures, according to students (56%; 87/155). Students seek out additional educational resources to supplement lectures every day or every other day (68%; 106/155). Many faculty agree that students often seek outside resources because lectures are confusing (35%; 28/81).

Of note, there were no statistically significant differences in responses based on student or faculty demographics such as sex, age, or ethnicity. Furthermore, there were no differences in faculty responses based on faculty status or amount of years teaching M1 and M2 medical students.

Qualitative Student Responses

Upon coding the student responses, 3 themes emerged: (1) recognition of personal learning strategies as an adaptive learner, (2) desire for equitable access to supplemental academic resources, and (3) methods to prepare for national exams.

Recognition of Personal Learning Strategies as an Adaptive Learner – The majority of students who participated in this survey were acutely aware of the individualized learning strategies needed for success. Some students delineated elaborate study plans with multiple steps, while others admitted to listening only to online prerecorded lectures. One student offered this strategy:

> Spend the first few days of a rotation studying from high yield resources (First Aid, Sketchy, Osmosis, Pathoma), study new flashcards, reviewing old flashcards. Only after I feel like I have a good bird's eye view do I start to watch recorded lectures on 2x speed, pausing to take notes when needed to supplement my learning (male, age 28 and above, M2).

These learning strategies and preferences speak to the ability medical students have in serving as "master adaptive learners"

Table 3. Student and Faculty Demographics (in % total)

	MCW Students (n=155)	US Students[a] (n=92,758)	MCW Faculty (n=81)	US Faculty[b] (n=179,238)
Sex				
Male	52.9	49.4	45.7	57.6
Female	45.8	50.6	51.9	42.3
Choose not to answer	0.6	NA	2.5	NA
Age				
18-22	1.3			
23-27	78.1			
28 and above (students)	18.1			
29 and below (faculty)			0	(unknown)
30-39			28.4	
40-49			19.8	
50 and above (faculty)			48.1	
Choose not to answer	1.3		2.5	
Ethnicity				
White/Caucasian	71.6	49.8	79.0	63.5
Black/African American	3.2	7.3	0	3.6
Asian/Asian American	14.2	22.5	13.6	19.9
Hispanic/Latino	3.2	6.5	1.2	3.3
American Indian/Alaska Native	0	0.2	0	0.1
Hawaiian/Other Pacific Islander	0	0	0	0
Other	NA	12.6	NA	5.1
Choose not to answer	6.5	0.9	4.9	4.2
Year in school				
M1	42.6			
M2	29.7			
M3	23.2			
Choose not to answer	0.6			
Years taught M1/M2 classes				
1-5			46.9	(unknown)
6-10			17.3	
10 and above			34.6	
Choose not to answer			0	
Faculty status				
Assistant professor			30.9	46.4
Associate professor			29.6	20.5
Professor			30.9	21.5
Lecturer			2.5	8.9
Other			4.9	2.8
Choose not to answer			0	NA

Abbreviations: M1, first-year medical student; M2, second-year medical student; M3, third-year medical student.
[a]Association of American Medical Colleges. FACTS: Applicants, Matriculants, Enrollment, Graduates, MD-PhD, and Residency Applicants Data. Accessed May 20, 2020. https://www.aamc.org/data-reports/students-residents/report/facts
[b]Association of American Medical Colleges. Faculty Roster: U.S. Medical School Faculty. Accessed May 20, 2020. https://www.aamc.org/data-reports/faculty-institutions/report/faculty-roster-us-medical-school-faculty

or the ability to rely on previous lived experiences to inform the acquisition of new content to meet and exceed the expectations of the curriculum.[21] Another example includes harnessing learning preference in an attempt to make better use of time, when faced with the inability to maintain focus during long periods of lecture time:

> I am not able to pay attention for the entire 4-hour lecture periods. Watching the lectures later allows me to speed up sections I am more familiar with, pause and replay sec-

Table 4. Student Likert Question Answers

Questions				Answers (valid % [raw number])		
Please rank how much you agree or disagree with each of the following statements	Median (IQR)	SD	D	NAD	A	SA
I prefer to use lectures as my main source of learning material	4.0 (2)	8.5 (12)	13.5 (19)	12.8 (18)	6.9 (52)	28.4 (40)
I attend lecture mainly to absorb as much of the material as possible	3.0 (2)	23.2 (32)	21.0 (29)	10.9 (15)	30.4 (42)	14.5 (20)
I prefer when lecturers incorporate multiple teaching modalities into their presentations	4.0 (2)	2.9 (4)	4.4 (6)	22.1 (30)	40.4) (55)	30.1 (41)
I rewatch lectures to review material	2.0 (3)	28.3 (39)	28.3 (39)	11.6 (16)	15.2 (21)	16.7 (23)
I find that educational resources (other than lecture) often explain material better than lecturers	4.0 (2)	0.7 (1)	9.7 (13)	24.6 (33)	34.3 (46)	30.6 (41)
I believe that lecturers often relate basic science principles to clinical practice	4.0 (1)	2.2 (3)	18.0 (25)	24.5 (34)	50.4 (70)	5.0 (7)

Abbreviations: SD, strongly disagree; D, disagree; NAD, neither agree or disagree; A, agree; SA, strongly agree; IQR, interquartile range.

Table 5. Faculty Likert Question Answers

Questions				Answers (valid % [raw number])		
Please rank how much you agree or disagree with each of the following statements	Median (IQR)	SD	D	NAD	A	SA
I think students use lectures as their primary source of learning material	4.0 (1)	1.3 (1)	19.5 (15)	22.1 (17)	37.7 (29)	19.5 (15)
I think that students attend lecture to absorb as much material as possible	4.0 (1)	1.3 (1)	19.5 (15)	24.7 (19)	46.8 (36)	7.8 (6)
I often incorporate multiple teaching modalities into my lectures	4.0 (1)	0 (0)	17.6 (13)	21.6 (16)	43.2 (32)	17.6 (13)
I feel that my lectures are organized effectively to best support learning	4.0 (1)	0 (0)	1.3 (1)	11.8 (9)	57.9 (44)	28.9 (22)
I often relate basic science principles to clinical practice in my lectures	4.0 (1)	0 (0)	4.2 (3)	8.3 (6)	45.8 (33)	41.7 (30)
I often wish I had more time to present my lecture material to students	3.0 (2)	2.7 (2)	31.1 (23)	27.0 (20)	24.3 (18)	14.9 (11)
I think students often seek outside resources because lectures are confusing	3.0 (2)	5.3 (4)	26.3 (20)	31.6 (24)	25.0 (19)	11.8 (9)
I regularly recommend outside resources to supplement lecture material (other than textbooks)	3.0 (2)	2.7 (2)	32.4 (24)	24.3 (18)	28.4 (21)	12.2 (9)

Abbreviations: SD, strongly disagree; D, disagree; NAD, neither agree or disagree; A, agree; SA, strongly agree; IQR, interquartile range.

tions that are unclear, and pause to take breaks to increase my efficiency overall…I'm not a morning person either, so watching the lectures later in the day allows me to take full use of my most productive times of the day (female, age 23-27, M1).

Students also acknowledged that not much content was lost if lecture was not physically attended:

> I never attended lecture. Prior to watching the lectures, I would make outlines or charts of the lecture PowerPoints…Before a test, I then would review my out-

lines/charts a few times. This worked extremely well for me, and there were several other students who I knew that had very similar study habits as mine. This allowed me to make my own schedule and gave way more flexibility (female, age 23-27, M3).

Desire for Equitable Access to Supplemental Academic Resources – Excessive cost of ancillary materials and, in turn, a competitive disadvantage emerged as an unanticipated theme. The high cost of medical school tuition coupled with the perceived need to purchase additional study tools becomes financially challenging for students. One student acknowledged:

> There are some students who choose not to buy the UWorld USMLE 1 and USMLE 2 question banks to save money but ultimately, in the long run, these question banks are what lead to success on the boards and NBMEs. Both of these question banks are essential to success and should be included in our tuition (female, age 23-27, M3).

Another student admitted, "I could not afford UWorld myself…I felt this could potentially have put me at a disadvantage compared to my peers at this institution and beyond" (female, age 28 and above, M3). Another student explained, "Review books and materials are pricey, and I found nowhere in our financial aid plan for this, especially third year" (female, age 23-27, M2). Finally, students recognized that they would prefer to make their own choices when purchasing supplemental materials based on their learning style, "Give my money back for the resource the school purchased and let me put it towards review materials or a question bank of my choice" (male, age 23-27, M2).

These comments indicate that students are conflicted by the cost of ancillary resources and are frustrated that access to supplemental resources encourages an unfair advantage for their peers with no financial restrictions. Students did recommend that the school should provide the popular educational resources upon matriculation to ensure equity for students from all backgrounds.

Methods to Prepare for National Exams – Successful completion of the USMLE Step 1 and various national subject exams weigh

heavily on students as they recognize the importance of these test scores on future career choices. This guides their intended methods of study and engagement in the medical school course work. One student explained, "In the first half of the year, I attended lecture all the time, but as Step 1 came, I stopped attending to better study" (male, age 23-27, M2).

The pressures of external, national exams are insurmountable. A reasonable consideration includes access to supplemental resources that parallel course work with national exams to alleviate the associated stress. One student said, "I found outside resources to be much more helpful than a majority of the first- and second-year lectures, as lecture material was not important for Step 1" (female, age 28 and above, M3), while another said, "I think my [NBME subject exam] scores would've been even better if I wasn't required to go to lectures all the time" (female, age 23-27,

Figure. Student vs Faculty Use and/or Awareness of Ancillary Resources

M3). One student expressed a perception that future residency programs will value Step 1 results more than attained course grades and went so far as to provide the number of hours saved when not attending a class in person:

> In my mind, doing well on Step 1 was so much more important than getting Honors in pre-clinical classes, because Step 1 is what residency programs value the most. Consequently, I gave up getting the extra credit points and didn't go to class in person so that I could have an extra 10 hours per week to study for Step 1 (watching 20 hours of lectures double speed leaves 10 hours saved, plus transportation time to and from school). I think this gave me a good foundation in medical knowledge, and it helped me to do pretty well on the Step 1 exam (male, age 23-27, M2).

Qualitative Faculty Responses
Faculty open-text survey results highlighted four themes: faculty perceptions of utilized learning resources, recognition of multiple learning styles, restrictions on time in the learning environment and desires for utilization of other teaching methods.

Faculty Perceptions of Utilized Learning Resources – A large percentage of the faculty respondents believed that students primarily and regularly used textbooks to supplement lecture. However, 1 faculty member emphasized that only "a FEW students use the required textbooks," further suggesting that some teaching faculty are cognizant that textbooks may not be as popular or as widely
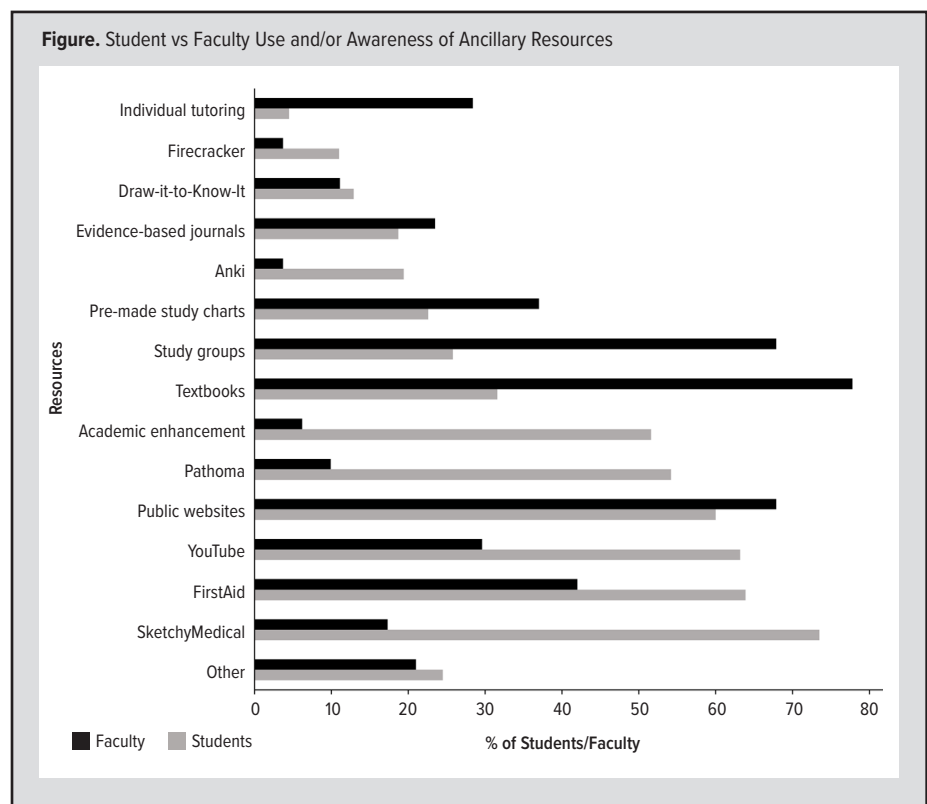
used as others believe. Faculty also perceived students using public websites such as YouTube, WebMD, and Wikipedia in addition to individual tutoring. One faculty (female, associate professor, 6-10 years teaching M1/M2 classes) did recognize that she had no knowledge of the resources students might be supplementing in addition to the traditional lectures and whether they are included in their tuition. Another faculty member indicated their perception of how students want to learn and the implications that has on personal teaching style:

> My experience is that they [students] want information delivered as efficiently as possible, which is a well-designed lecture. Sure, there is a lot of room for other modalities, but lecture bashing is very disappointing to those of us who do an excellent job of it (male, associate professor, >10 years teaching M1/M2 classes).

Recognition of Multiple Learning Styles and How to Address Them – A majority of faculty did recognize that medical students have multiple learning styles. From the survey responses, it appears that faculty are trying to meet the needs of their learners: "…Recognizing that there are multiple learning styles makes it important to present this information in multiple ways – which can be challenging" (female, professor, >10 years teaching M1/M2 classes). To address multiple learning styles, faculty self-identified a diverse set of pedagogical skills when facilitating the required didactic sessions for medical students. In the survey itself, many faculty wrote out an extensive outline on how they prefer to conduct the scheduled didactic time. Some faculty

mentioned gathering student background knowledge, teaching in smaller groups, and utilizing audience response systems:

> I like to survey the students first to see where they are in their learning…This is done in small groups. I do this to ensure that students know what they know. If students truly know the material, I encourage them to teach those that are not 100% clear on the material. I step away but keep my ears open. If the student teacher makes a vital mistake, I step in. Once the students feel they have mastered the material, I give them a clinical situation to test them. Based on their understanding, we adjust from there (unknown sex, assistant professor, 1-5 years teaching M1/M2 classes).

This level of thoughtfulness indicates that faculty are knowledgeable of teaching methodologies, student learning styles, and how to attempt to integrate those in the basic science education: "I aim to use both auditory and visual cues at a minimum and aim to have at least 1 application/kinesthetic activity in each didactic" (female, assistant professor, 1-5 years teaching M1/M2 classes). Another faculty member said, "When in large group teaching sessions, I like to mix methods. I usually do mini-lectures broken up by student small-group work. I often use audience response. I like to use humor as well" (male, associate p[rofessor, >10 years teaching M1/M2 classes).

Restrictions on Time in the Learning Environment – One of the most prevalent themes that emerged from the survey data was time constraints when teaching. A majority of the faculty responded that due to severe time restrictions and a large student body, lecture was the most concise and reliable method to get content to students. This was noted by both junior and senior faculty: "Time is THE constraint and lectures remain the best way to communicate large amounts of information" (male, associate professor, 10 or more years teaching). There is also mention of the negative connotation when referencing "lectures:" "Lectures are often considered a 'dirty word' as noted by one of our participants; however, when time is limited and content needs to be disseminated to a large body of students, faculty doubt that there are many tangible solutions" (male, associate professor, >10 years teaching M1/M2 classes).

Desires for Utilization of Other Teaching Methods – Conversely, a few faculty responded that lecture was not the favored method and that they would prefer to incorporate different strategies:

> Would prefer to move away from lecture toward small group discussions/focus groups in which students apply material that they have been given prior to class time. I do not like passive learning environment of lecture formats and would prefer a more active/dynamic format afforded by small group discussion requiring the learner to self-learn from previously deposited resources (male, assistant professor, 1-5 years teaching M1/M2 classes).

DISCUSSION

This study further informs the argument that traditional medical education does not adequately meet the needs and goals of medical students. As hypothesized, student and faculty perceptions regarding student learning needs were significantly different. The large effect size, coupled with a difference of over 1 expensive resource requiring the added burden of cost, time to locate, and review, indicates the educational relevance of the finding. Our study echoed the results of other studies in regard to lecture attendance and how students are utilizing lecture recordings. It was also clear that students prefer acquiring knowledge from interactive learning modalities and that faculty, in fact, desire – and many times attempt – to provide this to students through their instruction. Most medical students in this study reported using lectures as their main source of material but are spending time and money on additional educational resources available outside of the formal curriculum to enhance their learning and success on national exams. Thus, utilization of these outside educational resources is supplementing, or even replacing, material learned in the didactic lecture setting.

The USMLE Step 1 examination historically has had an inescapable effect on residency selection and career choices.[22,23] As a result, this exam has an unfortunate but very significant impact on medical student study patterns. However, in the spring of 2020, the USMLE announced that scoring for the USMLE Step 1 examination would switch to pass/fail in the near future.[24] In this announcement, stakeholders highlight the current "overemphasis" on the numeric score of the Step 1 examination, as well as its detrimental effect on medical student "well-being." While many perceive this as a step in the right direction for medical education as a whole, there are several implications that must be considered. These include a possible shift in emphasis to the numeric score of the USMLE Step 2 CK examination, as well as relying more heavily on medical school prestige in selection of residency applicants.[25] Supplemental commercial resource companies have already picked up on this trend, including the brand SketchyMedical, which released videos to assist in studying for the Step 2 CK examination shortly after this announcement.

The large volume of available products poses a challenge to learners as they must evaluate these resources for their usefulness and credibility prior to usage. For instance, the list of resources included in our survey is nowhere near comprehensive and was simply created via informal survey of MCW students. Therefore, learners allocate time and money seeking out and investing in these educational tools, which are used to supplement lecture-learning and prepare for institutional and/or national board examinations. Unexpectedly, the results of our study highlighted the large financial strain that individually purchasing ancillary resources places on students. Medical school graduates often complete their training with loans exceeding

$200,000.[26] Greater amounts of medical school debt have been shown to influence career decisions such as specialty selection, as well as personal choices regarding when to get married and have children.[27] Students often discover that they must allocate loan money to purchase perceived essential ancillary educational resources. Students who cannot afford these resources are placed at a competitive disadvantage, which may reduce their potential success in medical school and beyond. In prior studies, a financial need was significantly correlated with lower Step 1 scores.[22] Unfortunately, medical students learn early on in their medical education that any disadvantage that prevailed prior to matriculation may continue to plague their future goals – whether that is attainment of core competencies necessary for physicians, graduation requirements, or even specialty selection.

Results generated from self-reported surveys have some limitations. The overall response rate was relatively low, which decreases construct validity and interpretation of analytical results. Data from a single institution limits the generalizability of results. The survey was developed specifically for this study, thus limiting some elements of validity. Content validity is reduced by the survey's finite list of educational software. Concurrent validity of survey outcomes with student performance was precluded as survey results were anonymous.

The strength of our study included the fact that we garnered views from both students and the faculty who teach them, thus allowing for intriguing comparisons. Of the participants who responded, there was a reasonable spread between year in school of students and time that faculty had spent teaching M1 and M2 students.

Our study yielded compelling results on the use of supplemental resources by medical students, but additional research must be generated. Well-developed didactic lectures can remain a vital part of curricula but must be balanced with active-learning strategies to maximize student learning. Ultimately, 1 common theme remains certain: learner-centered medical education should be a principal focus of all medical curricula, in order to support adaptive learners who are prepared for lifelong learning.[28-31]

CONCLUSION

Student and faculty perceptions regarding student learning needs were significantly different. Students use lectures extensively but additionally add to the financial burden of medical school by personally funding supplemental resources. This study helps bridge the gap between medical students and faculty regarding what educational tools are best-suited to support a student population with increasingly diverse learning needs.

REFERENCES

1. Irby DM, Cooke M, O'Brien BC. Calls for reform of medical education by the Carnegie Foundation for the advancement of teaching: 1910 and 2010. *Acad Med.* 2010;85(2):220-227. doi:10.1097/ACM.0b013e3181c88449

2. Medical Education Curriculum Reports. Association of American Medical Colleges. Updated 2021. Accessed September 24, 2020. https://www.aamc.org/initiatives/cir/406470/06c.html

3. Association of American Medical Colleges. *Medical School Year Two Questionnaire: 2018 All Schools Summary Report.* Association of American Medical Colleges; 2019. Accessed April 23, 2020. https://www.aamc.org/download/496618/data/y2q2018report.pdf

4. Gupta A, Saks NS. Exploring medical student decisions regarding attending live lectures and using recorded lectures. *Med Teach.* 2013;35(9):767-771. doi:10.3109/0142159X.2013.801940

5. Bates M, Curtis S, Dismore H. Learning approaches and lecture attendance of medical students. *J Furth High Educ.* 2018;42(2):248-258. doi:10.1080/0309877X.2016.1261089

6. Topale L. The strategic use of lecture recordings to facilitate an active and self-directed learning approach. *BMC Med Educ.* 2016;16(1):201. doi:10.1186/s12909-016-0723-0

7. Roberts DH, Newman LR, Schwartzstein RM. Twelve tips for facilitating Millennials' learning. *Med Teach.* 2012;34(4):274-278. doi:10.3109/0142159X.2011.613498

8. Robin BR, McNeil SG, Cook DA, Agarwal KL, Singhal GR. Preparing for the changing role of instructional technologies in medical education. *Acad Med.* 2011;86(4):435-439. doi:10.1097/ACM.0b013e31820dbee4

9. Sadeghi R, Sedaghat MM, Ahmadi FS. Comparison of the effect of lecture and blended teaching methods on students' learning and satisfaction. *J Adv Med Educ Prof.* 2014;2(4):146-150. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4235559/pdf/jamp-2-146.pdf

10. Meguid EA, Collins M. Students' perceptions of lecturing approaches: traditional versus interactive teaching. *Adv Med Educ Pract.* 2017;8:229-241. doi:10.2147/AMEP.S131851

11. Sankey MD, Birch D, Gardiner MW. The impact of multiple representations of content using multimedia on learning outcomes across learning styles and modal preferences. *Int J Educ Dev Using Inf Commun Technol.* 2011;7(3):18-35. https://eprints.usq.edu.au/20856/2/Sankey_Birch_Gardiner_EDICT_201_PV.pdf

12. Khasawneh R, Simonsen K, Snowden J, Higgins J, Beck G. The effectiveness of e-learning in pediatric medical student education. *Med Educ Online.* 2016;21:29516. doi:10.3402/meo.v21.29516

13. Khogali SE, Davies DA, Donnan PT, et al. Integration of e-learning resources into a medical school curriculum. *Med Teach.* 2011;4:311-318. doi:10.3109/0142159X.2011.540270

14. Pettit RK, Kinney M, McCoy L. A descriptive, cross-sectional study of medical student preferences for vodcast design, format and pedagogical approach. *BMC Med Educ.* 2017;17(1):89. doi:10.1186/s12909-017-0926-z

15. Chen DR, Priest KC, Batten JN, Fragoso LE, Reinfeld BI, Laitman BM. Student perspectives on the "step 1 climate" in preclinical medical education. *Acad Med.* 2019;94:302-304. doi:10.1097/ACM.0000000000002565

16. Conole G, de Laat M, Dillon T, Darby J. "Disruptive technologies", "pedagogical innovation": what's new? Findings from an in-depth study of students' use and perception of technology. *Comput Educ.* 2008;50(2):511-524. doi:10.1016/j.compedu.2007.09.009.

17. Pickering J. Anatomy drawing screencasts: enabling flexible learning for medical students. *Anat Sci Educ.* 2015;8(3):249-257. doi:10.1002/ase.1480

18. Giordano C, Hutchinson D, Peppler R. A predictive model for USMLE step 1 scores. *Cureus.* 2016;8(9):e769. doi:10.7759/cureus.769

19. McGaghie WC, Downing SM, Kubilius R. What is the impact of commercial test preparation on medical examination performance? *Teach Learn Med.* 2004;16(2):202-211. doi:10.1207/s15328015tlm1602_14

20. Burk-Rafel J, Santen SA, Purkiss J. Study behaviors and USMLE Step 1 performance: implications of a student self-directed parallel curriculum. *Acad Med.* 2017;92(11S):S67-S64. doi:10.1097/ACM.0000000000001916

21. Regan L, Hopson LR, Gisondi MA, Branzetti J. Learning to learn: a qualitative study to uncover strategies used by master adaptive learners in the planning of learning. *Med Teach.* 2019;41(11):1252-1262. doi: 10.1080/0142159X.2019.1630729

22. Gauer JL, Jackson JB. The association of USMLE Step 1 and Step 2 CK scores with residency match specialty and location. *Med Educ Online*. 2017;22(1):1358579. doi:10.1080/10872981.2017.1358579

23. National Resident Matching Program Data Release and Research Committee. *Results of the 2018 NRMP Program Director Survey.* National Resident Matching Program; 2018. Accessed April 29, 2020. https://www.nrmp.org/wp-content/uploads/2018/07/NRMP-2018-Program-Director-Survey-for-WWW.pdf

24. United States Medical Licensing Examination. Change to pass/fail score reporting for Step 1. Accessed April 29, 2020. https://www.usmle.org/inCus/

25. Crane MA, Chang HA, Azamfirei R. Medical education takes a step in the right direction: where does that leave students? *JAMA*. 2020;323(20):2013-2014. doi:10.1001/jama.2020.2950

26. Youngclaus JJ, Bunton SA, Fresne J. AAMC analysis in brief: an updated look at attendance cost and medical student debt at U.S. medical school. Published August 2017. Accessed October 16, 2018. https://www.aamc.org/media/8751/download

27. Rohlfing J, Navarro R, Maniya OZ, Hughes BD, Rogalsky DK. Medical student debt and major life choices other than specialty. *Med Educ Online*. 2014;19:25603. doi:10.3402/meo.v19.25603

28. Emanuel EJ. The inevitable reimagining of medical education. *JAMA*. 2020;323(12):1127–1128. doi:10.1001/jama.2020.1227

29. AlFaris EA, Naeem N, Irfan F, Qureshi R, Van Der Vleuten C. Student centered curricular elements are associated with a healthier educational environment and lower depressive symptoms in medical students. *BMC Med Educ.* 2014;14:192. doi:10.1186/1472-6920-14-192

30. Cutrer WB, Miller B, Pusic MV, et al. Fostering the development of master adaptive learners: a conceptual model to guide skill acquisition in medical education. *Acad Med*. 2018;92(1):70-75. doi: 10.1097/ACM.0000000000001323

31. Ludmerer KM. Learner-centered medical education. *N Engl J Med*. 2004;351(12):1163-1164. doi:10.1056/NEJMp048112

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