Faculty and second-year medical student perceptions of active learning in an integrated curriculum

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Tsang A, Harris DM. Faculty and second-year medical student perceptions of active learning in an integrated curriculum. Adv Physiol Educ 40: 446–453, 2016; doi:10.1152/advan.00079.2016.—Patients expect physicians to be lifelong learners who are able to interpret and evaluate diagnostic tests, and most medical schools list the development of lifelong learning in their program objectives. However, lecture is the most often utilized form of teaching in the first two years and is considered passive learning. The current generation of medical students has many characteristics that should support active learning pedagogies. The purpose of this study was to analyze student and faculty perceptions of active learning in an integrated medical curriculum at the second-year mark, where students have been exposed to multiple educational pedagogies. The first hypothesis of the study was that faculty would favor active learning methods. The second hypothesis was that Millennial medical students would favor active learning due to their characteristics. Primary faculty for years 1 and 2 and second-year medical students were recruited for an e-mail survey consisting of 12 questions about active learning and lecture. Students perceived that lecture and passive pedagogies were more effective for learning, whereas faculty felt active and collaborative learning was more effective. Students believed that more content should be covered by lecture than faculty. There were also significant differences in perceptions of what makes a good teacher. Students and faculty both felt that lack of time in the curriculum and preparation time were barriers for faculty. The data suggest that students are not familiar with the process of learning and that more time may be needed to help students develop lifelong learning skills.

PATIENTS EXPECT THEIR PHYSICIANS to be lifelong learners with the ability to interpret dynamic guidelines for treatment, evaluate new diagnostic tests and technology, and communicate with multiple healthcare providers for optimal patient centered care. Therefore, the development of lifelong learning skills appears in the list of program objectives for many medical schools, and inclusion of these skills is mandated by the Liaison Committee for Medical Education under Standard 6 and Element 6.3. Development of lifelong learning skills should prepare students to self-regulate and take responsibility for their own learning, professional development, and ability to adapt to change (1, 30, 40). These underline the adult learning theory proposed by Knowles (17) called andragogy. It consists of five assumptions as an adult learner as someone who can direct their own learning, can learn from their experiences, has learning needs related to society, is problem-centered and is internally motivated to learn (17). To learn self-regulation, one must be engaged in the process of active learning, which helps learners develop their own mental models and construction of concepts and relationships (33). Providing educational encounters that allow students to engage with material and thus develop their own mental models should lead to better lifelong learning skills, which are especially critical for professional jobs such as doctors, nurses, and research scientists, to name a few.

Unfortunately, passive learning or lecturing remains the predominant form of teaching in multiple levels of education (2, 9, 24), including medical education, where ~55% of material is taught in the lecture format (6). The current model of undergraduate medical education has been noted to have shortcomings, including lack of efficiency, flexibility, and learner-centered pedagogy. This is in contrast to the Flexner (10) report, which was a commentary that has given rise to the modern medical education model used in the United States and Canada. In the report, Flexner criticized the lecture format and wanted students actively involved (10, 27). Because the vast amount of content within medical education is expanding, there has been a push to make better use of students’ time and make live lessons “stickier” to emphasize student engagement (34). One popular mechanism has been to “flip the classroom,” where a shortened lecture can be viewed as homework and class time is dedicated to applying the material. This has been used increasingly in the STEM disciplines. Crouch and Mazur (8) have coupled this method with peer instruction and shown increased student mastery in calculus and algebra-based physics courses. Flipping the classroom increases student engagement, as classroom attendance increased from 30 to 80% after this method was implemented in a biochemistry course (34). Other ways to augment active learning in medical education include the use of team-based learning (TBL), where students discuss problems and submit answers jointly for a grade. This has resulted in improved learning outcomes compared with lecture (18, 19, 22, 26, 36). Simulation-based education has also been utilized and includes task trainers, standardized patients, and virtual environments. The feedback components and repetitive practice have been shown to be very effective for learning (12, 15, 25). All of these active learning methods require students to think deeply and construct mental models, as opposed to simply memorizing facts, and should foster better learning.

The current generation of students, the Millennials, have the traits of being confident (goal-oriented and motivated), team-oriented, high-achieving, technology savvy, and pressured to succeed, which should favor the use of active learning methods over passive methods (14). Conversely, other characteristics such as feeling “special” and coming from a sheltered environment may give them the sense that they will always receive frequent positive feedback and that they will be spared from tough experiences because of parental involvement (14). This has most likely led to the studies that are quite mixed about student perception of active learning. Despite increases in
learning outcomes in pharmacotherapy and introductory psychology courses that promoted active learning, students perceived the learning experience as more negative (16, 37). In another study, students felt that lecture “soothes anxiety”, is an efficient way to learn, and provides structure and discipline (4). Additionally, poorly designed active learning sessions, which can be ineffective for learning, have caused students to have a negative outlook (38). On the other hand, there have been other instances where students were positive about active learning experiences. Students in a flipped linear algebra course at York University in Canada had positive experiences and preferred it over traditional formats (23, 32). In a recent study by Miller and Metz (29) that compared the perceptions of faculty and first-year dental students regarding active learning, students believed active learning to be more effective than the faculty did. The variable student perceptions of active learning suggest that there may be misconceptions of what learning is as well as its effectiveness.

Although there is substantial evidence showing improved exam scores and lower failure rates in active learning sections compared with traditional lecturing, many faculty still find it difficult to transition out of lecture-based teaching (11). Furthermore, there has been a limited amount of studies about faculty perspectives on active learning. A list of faculty barriers has been captured in a report by Joel Michael (28) in which the author presented a workshop on active learning at Niagara University for 29 faculty participants who taught science courses as well as humanities, social sciences, and education. Michael (28) summarized participant responses into three main categories, including teacher characteristics or problems, pedagogical issues, and student characteristics or attributes. The most frequent concerns of the teachers were lack of preparation time and the loss of control. There was also a widespread feeling that many faculty did not know how to design active learning sessions. From the pedagogical side, there were constraints such as classroom design and issues with respect to content coverage (28). As for student characteristics, faculty perceived that students do not come to class prepared, lack maturity, and are unwilling to engage. In a more recent study, similar barriers were perceived among dental school physiology faculty, where 89% of faculty felt that there was not enough class time to use active learning and 44% had become accustomed to lecture-based methods (29). They also reiterated lack of training and time to develop the curricular material necessary for active learning (29). The data from the limited studies on faculty perceptions of active learning suggest that lack of faculty training for active learning is a major barrier.

At the University of Central Florida College of Medicine (UCF COM), there has been an effort to decrease lecture time and promote active learning methods to achieve the advantages found through educational research. Similar to the experience at other institutions, this shift has been met with significant resistance by teachers and learners alike who have not embraced the new emphasis on active learning. Even with support from the administration, there has been very slow progress in this transition, and faculty still rely heavily on lecture in the first 2 yr (Table 1). This could be due to many factors such as too little protected time or training for development of active learning materials and perceived pressure for faculty to cover large amounts of content for the United States Medical Licensing Examination (USMLE) Step 1. There are also concerns about student perceptions, as they usually have limited experience with education or educational research literature and may not be able to differentiate between learning and rote memorization. This could result in poor course evaluations and have a detrimental effect on faculty annual reviews and promotion/tenure decisions.

The purpose of this study was to characterize faculty and student perceptions of active learning and effectiveness of methodologies that are utilized in an integrated MD program curriculum. Many answer choices were derived from comments from student focus groups and module evaluations. Second-year medical students were chosen because they had exposure to multiple types of learning pedagogies in the first year of the curriculum and early portion of the second year. The first hypothesis of the study was that Millennial medical students would have a positive view about active learning given the traits associated with that generation, which would appear to promote lifelong learning. The goal of this study was to discover where faculty and students could differ in their perception, which could support the need for increased faculty development opportunities and/or changes in student support services or education.

Table 1. Curricular breakdown of the first 2 yr by module at the University of Central Florida College of Medicine

<table>
<thead>
<tr>
<th>Year 1 Module</th>
<th>Primary Disciplines</th>
<th>Length of Module, wk</th>
<th>Time of Lecture, h</th>
<th>Time of Other Modalities, h</th>
<th>Time Devoted to Lecture, %h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellular function and molecular genetics</td>
<td>Biochemistry, cell biology, genetics</td>
<td>7</td>
<td>78</td>
<td>73</td>
<td>51.7</td>
</tr>
<tr>
<td>Structure and function</td>
<td>Anatomy, physiology, histology</td>
<td>17</td>
<td>95.5</td>
<td>208</td>
<td>31.5</td>
</tr>
<tr>
<td>Health and disease</td>
<td>Microbiology, immunology, pharmacology</td>
<td>8</td>
<td>80</td>
<td>65</td>
<td>55.2</td>
</tr>
<tr>
<td>Hematology/oncology</td>
<td>Pathology, pharmacology</td>
<td>4</td>
<td>27</td>
<td>34</td>
<td>44.3</td>
</tr>
<tr>
<td>Year 2 Cardiopulmonary</td>
<td>Pathology, pharmacology</td>
<td>6</td>
<td>73.5</td>
<td>36.5</td>
<td>66.8</td>
</tr>
<tr>
<td>Endocrine/Reproductive</td>
<td>Pathology, pharmacology</td>
<td>6</td>
<td>59.5</td>
<td>54.5</td>
<td>52.2</td>
</tr>
<tr>
<td>GI/renal</td>
<td>Pathology, pharmacology</td>
<td>6</td>
<td>52.5</td>
<td>51</td>
<td>50.7</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>Pathology, pharmacology</td>
<td>4</td>
<td>48</td>
<td>21</td>
<td>69.6</td>
</tr>
<tr>
<td>Brain and Behavior</td>
<td>Pathology, pharmacology</td>
<td>7</td>
<td>65</td>
<td>72</td>
<td>47.4</td>
</tr>
</tbody>
</table>

GL, gastrointestinal. Module name, the primary disciplines within the module, the length of module in weeks as well as hours of lecture, other modalities, and the percentage of total hours devoted to lecture are shown. Data were accumulated by viewing the academic calendar for the appropriate years for the students surveyed.
METHODS

Curriculum. The University of Central Florida College of Medicine has an integrated curriculum with three basic science modules and six systems-based modules, as outlined in Table 1, which shows the breakdown for academic year 2014–2015. There are also modules for practice of medicine and a module covering a mandatory research project, which are not included in Table 1, that also run simultaneously during the year. For Table 1, lectures were considered any teaching activity that took place in the large classroom, which was not TBL or case-based learning. Other modalities that were used and not considered lecture were e-learning modules, small group cases, laboratories, high-fidelity patient simulations, and self-study hours.

Faculty and student participants. Faculty participants were module directors and/or core faculty in the first 2 yr of the curriculum. Faculty were recruited for the survey by e-mail through Qualtrics and 12 of 24 primary faculty in years 1 and 2 completed the survey (50% response rate). Student participants were second-year MD students enrolled at UCF COM. Students were recruited for the survey by e-mail through Qualtrics, and 47 of 120 second-year medical students completed the survey (39% response rate). Students were compensated $10 for completion of the survey; the faculty did not receive any compensation. The survey was provided to students at the beginning of their second year during the endocrine and reproductive module and remained open for a total of 3 wk (late September into October 2015) and for faculty during the same time period and length. A reminder email was provided after the first 2 wk.

Survey instruments. The anonymous faculty and student surveys consisted of 12 questions that included ranking items, multiple choice, and Likert-like questions. Time (supplemental) required to complete the survey was estimated at <20 min. Student responses to question 11 were excluded because we felt that the answer choices were not clear. Answer choices were developed based upon feedback in student focus groups and evaluations unless otherwise indicated. Active learning was defined in the survey as “any instructional method that engages students in the learning process and requires students to do meaningful learning activities and think about what they are doing” by Bonwell and Eison (3).

Data analysis and institutional review board approval. This study was reviewed and given exempt status by the Institutional Review Board of the University of Central Florida, and students and faculty participated with informed consent. To assess the perceptions and obstacles of lecture vs. active learning, data were presented descriptively. All tests are two-sided, and $P$ values of $<0.05$ were considered statistically significant. For ranking statistics, a Mann-Whitney $U$-test was utilized between groups (35). For Table 4, within-group comparisons were done using the Wilcoxon Signed-Rank Test. Statistical analyses was performed using SPSS Statistics software (version 23.0; IBM, Armonk, NY).

RESULTS

When students start the second year of the curriculum at UCF COM, they have been exposed to a variety of teaching modalities. The purpose of the first question in the survey was to gain insight into how students and faculty felt about the effectiveness of different teaching modalities utilized at UCF COM. Participants were asked to rank learning modalities used at UCF COM from most effective to least effective (e.g., 1 = most effective, 7 = least effective). Figure 1 shows that there were significant differences in perception in four out of seven modalities between faculty ($n = 12$) and students ($n = 47$). Faculty ranked laboratories [students: 2.7 (1.7) vs. faculty: 3.9 (1.5)] and TBL sessions [students: 3.3 (2.1) vs. faculty: 5.5 (1.7)] as significantly more effective for learning than students. Students ranked lecture [students: 3.4 (1.9) vs. faculty: 5.6 (1.5), $P < 0.05$] and self-study hours [students: 3.5 (2.1) vs. faculty: 5.5 (2.2), $P < 0.05$] as significantly more effective than faculty rankings. Simulation was ranked as the most effective modality by faculty and students. As seen in Fig. 1, faculty felt that the activities that were hands-on and involved teamwork were more effective for learning in contrast to the student perception that passive and isolated modalities (lecture and self-study) were superior.

Faculty are expected to help students develop higher-order thinking skills as part of their training; however, students may feel uncomfortable because they may not be familiar with the learning process. The purpose of the next question was to ascertain student and faculty perceptions of the best approaches for learning by asking them to rank learning actions. The answer choices were based upon Bloom’s taxonomy pyramid, where some items were considered lower-order thinking (reading, listening, and viewing) and some were considered higher-order thinking or deeper learning such as designing an experiment or giving a talk. Figure 2 shows that there were significant differences between the faculty and student responses on the actions of giving a talk [students: 3.2 (1.7) vs. faculty: 2.0 (0.9), $P < 0.05$] and designing a simulated experiment [students: 3.0 (1.5) vs. faculty 1.7(1.0), $P < 0.05$]. There were no significant ranking differences between students and faculty on viewing a Youtube video, reading a section of text, or listening to a lecture. The main conclusion from this survey question is that faculty rank higher-order thinking skills as more effective for learning than do the students.

A general goal of the University of Central Florida MD program is to reduce lecture time so that <30% of course material is delivered with that method. The purpose of the next question was for students and faculty to choose what percentage of module material they believe should be presented in lecture format to determine whether perceptions lie within the goals of the curriculum. Figure 3 shows that all faculty surveyed believed that lecture should be used <60% of the time, with the majority feeling that the ideal amount is 21–40%, which was close to the school goal. Students, on the other hand, believed that lecture should constitute higher percentages of content delivery, with the highest percentage believing that
with the definition of active learning in the survey (see methods), with 1 = strongly disagree and 5 = strongly agree.

Questions 1 and 3 were based on the survey from Miller and Metz (29), who examined active learning perceptions of dental students and faculty. Students and faculty were very similar and neutral as to whether students preferred active learning methods. Interestingly, students did not feel that active learning would improve their exam scores as much as faculty believed [students: 3.4 (1.0) vs. faculty: 4.1 (0.80), P < 0.05]. Questions 2 and 4 aimed to address student viewpoints on what constitutes a good teacher or faculty member. There was a striking disconnect between students and faculty on what constitutes an excellent teacher [students: 4.2 (1.0) vs. faculty: 1.7 (0.5), P < 0.001]. Students agreed with the statement that an excellent teacher provides comprehensive notes, whereas faculty disagreed that this is a practice of excellent teachers. Questions 5 and 7 aimed to address perceptions of peer learning from a faculty and student perspective. There were no significant differences in either question, but students had a tendency to perceive that they learned better as individuals than in collaboration with other classmates. Question 6 aimed to address the concern from faculty that many students are not prepared for active learning sessions because they do not do the assigned work beforehand. This was confirmed, as faculty perceived that students do not do the appropriate reading and preparation for active learning sessions [students: 3.2 (1.3) vs. faculty: 2.3 (0.6), P < 0.05]. To summarize, faculty and students have different opinions on the benefit of active learning for exam performance as well as preparation for active learning sessions. There is also a significant difference in opinion on what constitutes an excellent teacher as defined by the statement.

Despite the educational research showing the benefits of active learning as well as ample online resources and faculty development opportunities at national meetings, faculty face challenges in implementing active learning methods. Michael (28) as well as Miller and Metz (29) have highlighted some of the barriers for faculty, and their findings were used for the statements provided in the survey. The purpose of this question was to clarify what students and faculty felt were barriers for implementing active learning sessions. Faculty and students were asked to rank the barriers from the greatest to the smallest (1 = greatest barrier, 8 = smallest barrier). Faculty and students agreed that one of the top barriers for the use of active learning is the lack of time in the curriculum (Table 4) and

### Table 2. Faculty responses for the greatest reason to use lecture

<table>
<thead>
<tr>
<th>Response</th>
<th>%Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have a lot of material to get through in a short amount of time.</td>
<td>8</td>
</tr>
<tr>
<td>The topic is complex and key to student understanding.</td>
<td>50</td>
</tr>
<tr>
<td>They will remember it better if they can place a faculty face on it.</td>
<td>0</td>
</tr>
<tr>
<td>There is a need to supply basic information that can be developed later.</td>
<td>33</td>
</tr>
<tr>
<td>Faculty members have experience that they can relay to the students.</td>
<td>8</td>
</tr>
<tr>
<td>Lecture should never be used.</td>
<td>0</td>
</tr>
</tbody>
</table>

Data are presented as percentages of total faculty. The question asked was, “What do you believe is the greatest reason for providing lecture on a topic as opposed to active learning methods?”

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**Fig. 2.** Faculty and student rankings of how students learn best about a particular subject. The purpose of the next question was to ascertain student and faculty perceptions of the best approaches for learning about a generic subject (subject A) by asking them to rank learning actions. Faculty and students were asked to rank actions in the order that students learn best about a subject, where 1 = the best and 5 = the least. Data are presented as means (SD); n = 12 for faculty and 47 for students. *P < 0.05 by the Mann-Whitney U-test.

**Fig. 3.** Comparison of feelings regarding the percentage of module material presented in lecture format. Faculty and students were asked to choose what percentage of lecture they believed should be presented in lecture format. Data are presented as %respondents; n = 12 for faculty and 47 for students.
ranked that significantly higher than other barriers. Faculty also ranked that lack of preparation time to create active learning sessions as a significantly greater barrier than other statements. One conclusion from this graph is that faculty and students feel that lack of time within the curriculum is a major barrier for implementation of active learning methods. Faculty also felt that a significant barrier is the lack of time provided to create active learning sessions.

### Discussion

Physicians as well as other professionals are expected to become lifelong learners to deal with the dynamic challenges they face as well as technology advances. Despite substantial evidence that active learning promotes better long-term learning and lifelong learning skills and that characteristics of the millennial generation should favor active learning environments, there is considerable hesitance by faculty to make this transition from traditional lectures given student reaction. This study aimed to determine differences in faculty and second-year medical students’ perceptions regarding learning, with particular emphasis on active learning vs. lecture. The main findings of the current study were as follows: 1) Faculty perceived that team-related educational activities such as TBL and laboratories were more effective for learning than students, whereas students felt that lecture and self-study hours were more effective for learning than faculty; 2) faculty perceived higher-order thinking activities as being more effective for learning than did students; 3) students believed that a higher percentage of module material should be delivered by lecture compared with faculty; 4) students perceived an excellent teacher to be one that provides detailed notes so that they do not have to pursue other resources; and 5) both faculty and students felt that there was not enough time in the curriculum for active learning methods or a lack of time for faculty preparation.

The largest area of disagreement between the faculty and students was regarding the effectiveness or amount of lecture and/or passive learning compared with active learning methods. This can be documented in Fig. 1, where students ranked lecture as the second most effective, as faculty ranked it as one of the least effective. Likewise, when students were asked to rank the most effective action for students to learn, they chose passive learning methods compared with active learning methods (Fig. 3). The majority of students also felt that >61% of module material should be delivered via lecture compared with faculty, who believed that <40% should be. In the study by Miller and Metz (29), students were very positive about active learning. Interestingly, despite student enthusiasm for active learning, they still favored only 40% of lecture time devoted to active learning, which means that they believe 60% of the time

Table 3. Faculty vs. student responses to statements involving active learning and teaching

<table>
<thead>
<tr>
<th>Statement</th>
<th>Student Response Average</th>
<th>Faculty Response Average</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Students/I) prefer active learning over lectures.</td>
<td>3.2 (1.1)</td>
<td>3.2 (0.9)</td>
<td>0.96</td>
</tr>
<tr>
<td>(Students/I) prefer faculty members who tell (them/me) “what (they/I) need to know” for exams over faculty who consistently ask thought-provoking questions.</td>
<td>3.7 (1.0)</td>
<td>3.8 (1.0)</td>
<td>0.64</td>
</tr>
<tr>
<td>(Students/MY) performance on exams would improve from the use of active learning in the classroom.</td>
<td>3.4 (1.0)</td>
<td>4.1 (0.80)</td>
<td>0.04</td>
</tr>
<tr>
<td>An excellent teacher is one who provides notes detailed enough so that students do not have to pursue other resources.</td>
<td>4.2 (1.0)</td>
<td>1.7 (0.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(Students/I) feel as though (they/I) can learn more individually than in a group of their/my peers.</td>
<td>3.7 (1.0)</td>
<td>3.1 (0.8)</td>
<td>0.08</td>
</tr>
<tr>
<td>(Students/I) do the appropriate prepradings and work prior to a scheduled active learning event.</td>
<td>3.2 (1.3)</td>
<td>2.3 (0.6)</td>
<td>0.03</td>
</tr>
<tr>
<td>(Students/I) feel like they/I learn more by reviewing lecture videos and Powerpoints than through collaborative active learning sessions.</td>
<td>3.6 (1.0)</td>
<td>3.8 (0.8)</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Data are means (SD); n = 12 for faculty and 47 for students. The prompt for each statement is followed by faculty and student responses. For the Likert-like responses, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Results for statements were compared using Mann-Whitney U-tests, and P < 0.05 was considered significant.

Table 4. Faculty vs. student-perceived barriers for the use of active learning

<table>
<thead>
<tr>
<th>Statement</th>
<th>Student Response Average</th>
<th>Faculty Response Average</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is not enough time in the curriculum.</td>
<td>1.8 (1.1)*</td>
<td>3.2 (2.0)†</td>
<td>0.02</td>
</tr>
<tr>
<td>There is not enough time to create active learning sessions.</td>
<td>3.7 (1.9)</td>
<td>2.8 (2.0)†</td>
<td>0.11</td>
</tr>
<tr>
<td>There are too many students for active learning to work.</td>
<td>4.2 (1.6)</td>
<td>5.0 (1.6)</td>
<td>0.60</td>
</tr>
<tr>
<td>There are too few faculty for active learning to work.</td>
<td>4.9 (1.7)</td>
<td>4.1 (1.7)</td>
<td>0.27</td>
</tr>
<tr>
<td>There may be a decrease in the individual/module evaluation score.</td>
<td>6.2 (1.6)</td>
<td>5.5 (2.3)</td>
<td>0.47</td>
</tr>
<tr>
<td>There is a lack of training in the area of active learning.</td>
<td>5.5 (1.8)</td>
<td>5.0 (2.1)</td>
<td>0.44</td>
</tr>
<tr>
<td>Less material will be covered than during a lecture.</td>
<td>3.3 (2.4)</td>
<td>4.3 (2.0)</td>
<td>0.13</td>
</tr>
<tr>
<td>There is a fear that the faculty member is not in control of the class.</td>
<td>6.5 (2.1)</td>
<td>6.8 (2.2)</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Data are presented as means (SD); n = 12 for faculty and 47 for students. The prompt for each of the statements is followed by faculty and student responses. For Likert-like responses, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Faculty and student responses were compared using the Mann-Whitney U-test, and P < 0.05 was considered significant. Within-group responses were compared using the Wilcoxon signed-rank test, and P < 0.05 was considered significant; *P < 0.05 vs. other statement averages within student group; †P < 0.05 vs. other statements within faculty group.
should remain lecture-based instruction. These numbers are not drastically different from the student data in our study. However, the students in our study were less enthusiastic about active learning, as responses were close to neutral in regard to preference of active learning and whether it would improve their scores (Table 3). One of the differences in student enthusiasm for active learning methods may be the timing of the survey. Miller and Metz (29) distributed their student survey in the last week of the dental physiology class, whereas with the current study the survey was distributed at the beginning of the second year of the medical school curriculum. This may be important because at the time of our survey, students are about 6 mo away from taking Step 1. According to the University of Louisville School of Dentistry’s website, physiology is taught in the fall semester of year 1, which is at least 1 yr before the dental boards. Because of this, second-year medical students may feel pressure to study for classroom activity as well as board preparation, thus limiting time outside the classroom. Another difference between the current study and the Miller and Metz (29) study is that by the time students participated in our survey, they had been exposed to at least 20 different lecturers with varying styles compared with five in the Miller and Metz study. They have also been introduced to various active learning methods from many faculty. The proper design of active learning sessions has been shown to play a major role in student perceptions of it and could be a reason for the relatively neutral student scores on active learning (Table 3). This was observed at the University of Virginia School of Medicine, when they changed their curriculum to highlight student engagement and active learning. They discovered that the physical studio space, learner interactions, and quality of learning affected student engagement and participation (38).

One of the main points from their study is that if sessions were poorly executed, students felt that attendance was a waste of their time. Faculty ranked the lack of time to create active learning sessions as the greatest barrier that could have affected the quality of their active learning sessions. Inadequately protected time for creation of these sessions could result in ineffective activities, which could affect student perception in our study (Table 4). Students who feel pressed for time may find limited value in participating in poorly designed active learning sessions with the USMLE Step 1 looming. Faculty may also need additional training on development of active learning sessions, and opportunities could be provided for optimization of sessions before deployment.

Faculty and students also had different perceptions about the role of collaborative or team-related learning activities. Most medical students are Millennials, who have been known to be team-oriented and less comfortable working independently and prefer to work in collaborative group settings to prevent personal failure (5, 7). Our data did not concur fully with this trait, as students did not rank laboratory and TBL sessions as high as faculty as being most effective for learning (Fig. 1). Results were more mixed when students were asked whether they learn more individually than in a group (Table 3). This could be due to the summative portions, such as peer evaluation in gross anatomy laboratory and readiness assessment tests in TBL, where students may feel pressure to be prepared. Another issue could be that students do not receive adequate teamwork skill development, where feedback is essential for team growth. True TBL has a peer evaluation grade, and PBL typically has ample feedback; however, within our curriculum there is little feedback regarding teamwork skills. Further interventions may be needed to help with this critical attribute, as students may lose confidence in teamwork skills if feedback is not provided.

The results of this study suggest that students may not understand what learning is or the role of the teacher in the learning process. Students may think that acquiring new knowledge constitutes learning, which could equate to hearing about a disease for the first time in the classroom. Some faculty may also fall under this misconception, as lunchroom conversation often includes phrases such as “I told them about that in class!” or “I covered that,” indicating that they believe students learn everything that is spoken to them. Faculty most likely realize that being able to synthesize information for a talk or designing an experiment requires you to have transferred knowledge into real-life situations, as indicated in Fig. 2, but students may not. There was also strong disagreement between students and faculty in what constitutes an excellent teacher (Table 3), indicating that the role of teacher may need to be defined better if self-regulated learning is the goal. The role of assessment also needs to be considered in driving student learning and the role it has on their perceptions of active learning and educators. For instance, if lectures provide knowledge-level content, as opposed to analysis and evaluation, and course examinations test at the knowledge level, the reward for students will be to stick with their lecture notes. Further analysis needs to be done to look at the cognitive level of examination questions and decipher knowledge-based questions from those requiring a student to analyze a novel situation and transfer the basic knowledge information.

In fact, courses could be doing a disservice to students by assessing at a knowledge level since the USMLE Step exams typically consist of second- and third-order questions that require application and synthesis of basic facts. This misconception of learning could be addressed by presenting students with evidence-based educational research that shows the benefits of active learning over passive learning. Additionally, learning platforms such as Osmosis and SuperMemo, which can help students learn how to self-regulate, could be emphasized more (13, 39). These learning platforms incorporate effective study techniques such as spaced repetition test-enhanced learning and interleaved practice. It is important to address potential faculty misconceptions by providing opportunities to become informed of evidence-based educational research that could be done through journal clubs and webinars offered by many societies as well as inviting educational research experts for seminars.

Another factor that can play a role in student learning and perceptions is the hidden curriculum. It has been defined as the "subtle or not so subtle messages that are not part of the intended curriculum" (20). One of the challenges in the hidden curriculum includes the pressure for students to score well on USMLE Step 1 to get matched into competitive residencies, which leads to parallel studying, where a student is studyingboard material alongside preparing for course work. Students are also often advised by senior students to use additional websites, videos, and resources. This causes a competition for student time in and out of the classroom that can be detrimental, as active learning methods often require students to do work outside of the classroom to have productive in-class sessions. Table 4 supports this possibility, as students per-
receive lack of time in the curriculum as their primary barrier for active learning. Allocation of resources can also play a role in the hidden curriculum. Students may sense that faculty do not have sufficient preparation time if active learning materials are not well designed. Likewise, faculty may not have offices or protected time from other responsibilities, which limits their availability. These may play a role, as students and faculty indicated that there is not enough time in the curriculum for creating active learning sessions in their top three barriers (Table 4). Protected time for faculty development and training needs to be considered by administration if there are goals for increasing active learning methods.

One limitation of this study is the response rates (39 and 50% for students and faculty), which may appear low. However, these response rates are consistent with what is commonly seen in e-mail or online survey response rates, as one review compared several studies where the online response rate ranged from 20 to 47% and was consistently lower versus paper-based surveys (31). It is important also to recognize that assumptions about Internet-based surveys being more available and easier than paper do not result in a better response rate, as Leece et al. (21) found that surgeon members of the Orthopaedic Trauma Association responded to paper surveys at a higher rate than Internet-based surveys (58 vs. 45%). It is possible that the faculty or students who chose not to participate do not advocate for active learning as strongly as those that do. However, since students did not feel very strongly positive about active learning, having a higher response rate would most likely not work in favor of the active learning component and would promote larger differences between faculty and students. It is possible that faculty less in support of active learning did not participate in this survey, which is a challenge for many educators. To support faculty who are champions of active learning, we have started a group called “Meaningful and Impactful Learning Encounters” supported by the Office of Faculty Development to help faculty develop their teaching and encourage faculty. Another confounding factor in our school is that every student is required to complete a research project in the first 2 yr of the curriculum, and therefore, students are often confronted with numerous surveys to complete, which often reduces response rates of projects.

This study is also limited to student and faculty perceptions at one school with an integrated curriculum and it is unknown whether these findings can be transferred to other curricula, learning environments, or other faculty and students. The results of this study are relevant to the curricula of medical schools, nursing schools, and other majors or programs at universities. Faculty often evaluate their course in isolation, not taking into account other courses or parts of their curriculum that play a role in student education, health, and life choices. The results of this study will hopefully motivate faculty to account for other aspects of student education when designing their teaching sessions. Faculty development sessions could be targeted to help faculty with design of class and also provide mechanisms on how to convince your students that the hard work of active learning promotes better long-term outcomes. Furthermore, faculty often receive lower scores from students on evaluations when transitioning to active learning sessions. Therefore, this should be considered in annual evaluations or promotions portfolios. Another way to counterbalance the weight of student evaluations is to develop a peer evaluation system, as has been developed at UCF COM.

To our knowledge, there has been no study evaluating student and faculty perceptions of active learning in an integrated medical curriculum, particularly after 1 yr of instruction. Therefore, the aim of this study was to gain insight from second-year medical students with exposure to multiple lecturers and active learning techniques and faculty. Although the process of learning may be similar among all learners, medical students and faculty have unique pressures such as Step 1 performance for residency placement and accreditation, which play a role in the learning environment. Although dental schools have similar pressures, the results of this study do not suggest strong student support for active learning sessions, as seen in the Miller and Metz study (29). Furthermore, the current study suggests that the surveyed medical students deviate from the typical traits of Millennial learners as far as being team oriented, thus refuting our hypothesis. Much of the data support the notion that students may have misconceptions of what constitutes learning. Further studies are needed to fully elucidate this issue and determine whether more curricular time should be devoted to helping students develop lifelong learning skills instead of content knowledge.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

A.T. and D.M.H. conception and design of research; A.T. performed experiments; A.T. analyzed data; A.T. and D.M.H. interpreted results of experiments; A.T. and D.M.H. approved final version of manuscript; D.M.H. prepared figures; D.M.H. drafted manuscript; D.M.H. edited and revised manuscript.

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