

# Analyzing the impact of onsite vs. offsite lectures on medical student lecture participation: case study of the University of Toronto Faculty of Medicine

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## Abstract

**Background:** Current broadcasting technology enables distance learning but the impact of such on medical student participation is unknown. Here we evaluate student participation amongst second year medical school students comparing offsite vs onsite/in-person lectures at the University of Toronto Faculty of Medicine St. George (STG) and Mississauga Academy of Medicine (MAM) campuses.

**Methods:** Questions asked per offsite vs onsite lecture was compared as a measure of student participation at each campus and analyzed for course type (Concepts, Patients and Communities 3, CPC-3, and Life Cycle, LC), and lecture category (*Lecture only, ISAL only, and Lecture and ISAL*). Unpaired, t-tests were used to determine statistical significance (p-value <0.05).

**Results:** A total of 102 lectures (86 at STG, 16 at MAM) yielded 239 questions by STG students (213 onsite, 26 offsite) and 46 questions by MAM students (22 onsite, 24 offsite). When comparing onsite to offsite lectures, STG students asked 1.13 and 0.85 more questions per lecture and 0.83 fewer questions per lecture for *Lecture only, Lecture and ISAL, and ISAL only* categories, respectively (p-values of 0.09, 0.19, and 0.61, respectively). When comparing onsite to offsite lectures, MAM students asked 1.08, 1.10, and 1.25 more questions per lecture for these same categories (p-values of <0.0001, <0.0001, and 0.01, respectively).

**Conclusions:** Students are statistically likely to ask more questions when the lecturer is physically present than through distance learning. Future observational studies are needed to identify reasons for these differences and the corresponding impact on student learning and performance. The overall goal is to maximize learner participation.

## Introduction

Lecture participation is a key educational factor that can facilitate medical students' preclinical learning. There is widespread benefit of asking questions in students of varying ages, classes, and professions.<sup>1</sup> Technology-based learning has become increasingly prevalent in formal education.<sup>2</sup> There is evidence that technology-mediated distance learning, if used appropriately, can create learning outcomes comparable to or better than that of classroom-based learning.<sup>3,4</sup> Current technology allows for distance learning – lecturers can live stream classes to students across vast geographical locations. Broadcasting lectures also empowers students to actively participate in classroom discussions and ask clarifying questions.

The effect of technology-mediated learning is strongly related to learning engagement and participation.<sup>5</sup> Learning engagement is positively correlated with emotional engagement such as learning interest or satisfaction.<sup>6</sup> Previous studies have found that using video contents to deliver learning materials negatively affects students' participation which consequently reduces perceived learning effectiveness.<sup>5</sup>

Effectively, some Canadian and international medical schools take advantage of such learning tools to standardize the educational experience offered across their various satellite campus sites. Canadian medical schools, such as the University of Toronto and the University of British Columbia, offer distance learning through such satellite sites. Despite increased implementation, the impact of distance learning on medical student participation is a largely unstudied area of research. The purpose of this study is therefore to determine whether student participation varies based on the physical presence of the lecturer (i.e. onsite/in-person) compared with their broadcast from a remote location (i.e. offsite). The second-year class at the University of Toronto Faculty of Medicine class of 2022 will be used as a case study to investigate this relationship.

## Case study: University of Toronto Faculty of Medicine

The University of Toronto Faculty of Medicine is one of 17 medical schools in Canada.<sup>7</sup> There are approximately 259 medical students in each graduating class at the University of Toronto with

### Abbreviations and acronyms:

CPC-3 - Concepts, Patients and Communities 3 course

ISAL - Integrated Summary and Application Lecture

LC - Life Cycle course

CC - Complexity and Chronicity course

MAM - Mississauga Academy of Medicine campus (Mississauga)

STG - St. George campus (downtown Toronto)

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some variation in class size attributable to leaves of absence and MD/PhD training.<sup>8</sup> These 259 medical students are split between the St. George campus (STG) in downtown Toronto and the Mississauga Academy of Medicine campus (MAM) in Mississauga. Typically, STG has a class size of 205 students while MAM has 54 students.<sup>9</sup>

The University of Toronto's four-year medical school program is split into two years of pre-clinical learning, known as the pre-clerkship Foundations curriculum, and two years of clinical exposure through clerkship. The Foundations curriculum contains six didactic courses: Introduction to Medicine; Concepts, Patients and Communities 1; Concepts, Patients and Communities 2; Concepts, Patients and Communities 3 (CPC-3); Life Cycle (LC); and, Complexity and Chronicity (CC).<sup>10</sup> The first three courses are taught in the first year of study while the latter three courses are taught in the second year of study. Each course is composed of one-to-four-week blocks that cover a range of medical topics while continuously revisiting and building on previously taught concepts. Students take a test at the end of each block to demonstrate proficiency in the material. To facilitate student learning, there are three hours of didactic lectures weekly with an additional Integrated Summary and Application Lecture (ISAL) at the end of each block. ISALs are typically three-hours in total allocated time but are often subdivided into two or three 1-2 hour lectures. These lectures are dedicated to solidifying concepts covered in each block and applying the key concepts to clinical scenarios in preparation for the test. ISALs occasionally have mandatory attendance whereas all other didactic lectures featured in this study have non-mandatory attendance. All didactic and ISAL lectures are recorded and posted onto students' medical education portal with the exception of patient interviews from ISALs.

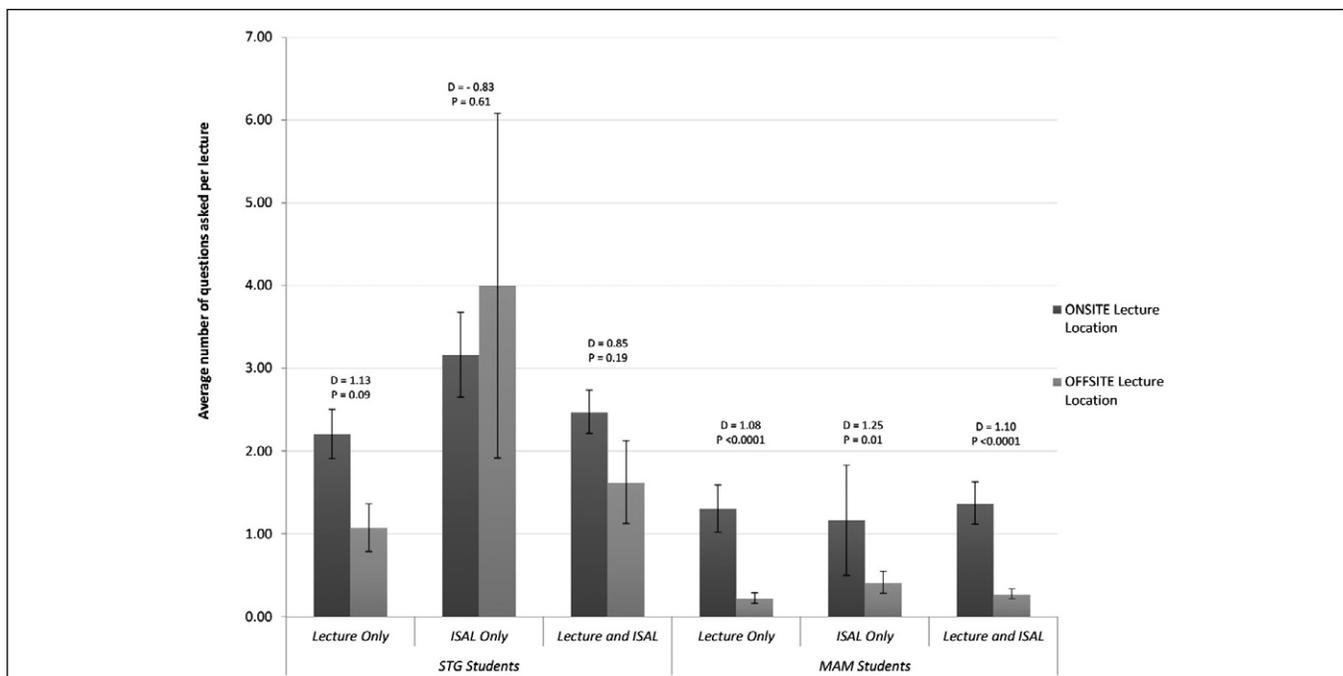
To facilitate distance learning, lectures held in one campus' auditorium are broadcast in real time to the lecture room screen

of the other site. Students at both campuses have the opportunity to participate by asking clarifying questions or responding to a lecturer's question. This process involves pressing a button at the student's desk that focuses the camera on them and activates their microphone, thereby allowing their question to be simultaneously heard at both locations. Lecturers are notified when a student has pressed their button.

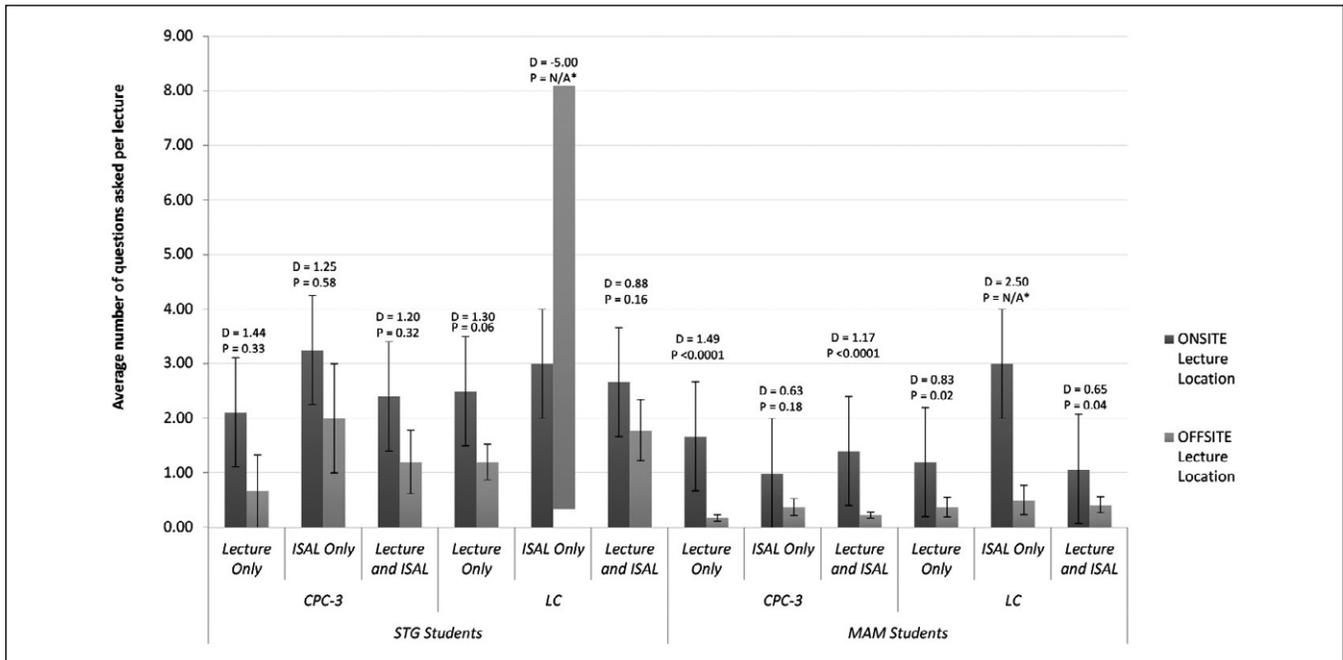
## Methods

The second-year medical school class (graduating class of 2022) was chosen as the study population at the time of data collection. Second-year students have been exposed to the pre-clinical learning environment for one year and are therefore assumed to be familiar with how to participate in lectures. The COVID-19 pandemic coincided with the start of the CC block for second year students. Consequently, second-year students had only completed the CPC-3 and LC courses prior to the institution's transition to online lectures for the CC course. Thus, this study only investigated the CPC-3 and LC courses, which account for 24 weeks of educational material.

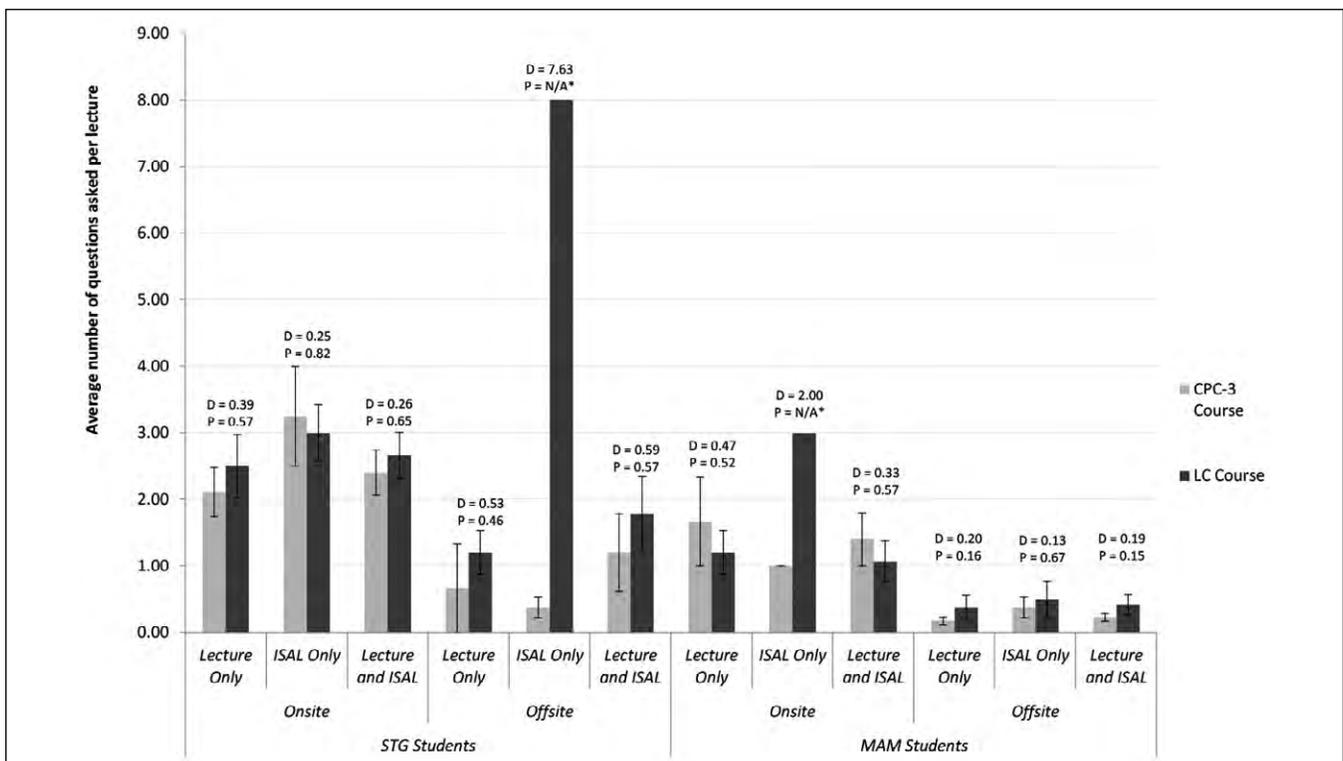
The number of questions asked by students during lectures was used as a measure of student participation at each site. Neither course offered participation marks to incentivize student participation. An intra-campus comparison (i.e. STG vs STG; MAM vs MAM) was used due to the large differences in class size between campuses. Questions were stratified by lecture location, comparing onsite lectures (e.g. MAM student asking question when lecture is at MAM location) with offsite lectures (e.g. STG student asking question when lecture is at MAM location). The physical location of the student asking a question was taken into consideration rather than their assigned campus because students can freely attend lectures in both auditoriums. To this end, a student enrolled in the MAM academy



**Figure 1.** Comparison of average number of questions asked per lecture, with CPC-3 and LC courses summed together\*  
 D: Difference between average number of questions asked per onsite lecture minus per offsite lecture; P: P-value  
 Note: Error bars represent standard error of mean. \*Note: Averages are unadjusted for the number of students in attendance at each lecture



**Figure 2.** Comparison of average number of questions asked per lecture between CPC-3 and LC courses\*\*  
 D: Difference between average number of questions asked per onsite lecture minus per offsite lecture; P: P-value  
 N/A\*: Unable to perform unpaired, t-test as there was only one ISAL lecture at the MAM location  
 Note: Error bars represent standard error of mean. \*\*Note: Averages are unadjusted for the number of students in attendance at each lecture



**Figure 3.** Comparison of average number of questions asked per lecture between onsite and offsite locations\*\*  
 D: Difference between average number of questions asked per onsite lecture minus per offsite lecture; P: P-value  
 N/A\*: Unable to perform unpaired, t-test as there was only one ISAL lecture at the MAM location  
 Note: Error bars represent standard error of mean. \*\*Note: Averages are unadjusted for the number of students in attendance at each lecture

**Table 1. Total number of lectures and questions asked across each course and category between STG and MAM students**

	STG Students				MAM Students			
	ONSITE		OFFSITE		ONSITE		OFFSITE	
	Number of Lectures	Total Questions Asked						
<b>Lecture Only</b>								
CPC-3	46	97	3	2	3	5	46	8
LC	16	40	10	12	10	12	16	6
Total	62	137	13	14	13	17	62	14
<b>ISAL Only</b>								
CPC-3	16	52	2	4	2	2	16	6
LC	8	24	1	8	1	3	8	4
Total	24	76	3	12	3	5	24	10
<b>Lecture and ISAL</b>								
CPC-3	62	149	5	6	5	7	62	14
LC	24	64	14	25	14	15	24	10
Total	86	213	16	26	16	22	86	24

**Table 2. Average number of questions asked per lecture\***

	STG Students		MAM Students	
	ONSITE	OFFSITE	ONSITE	OFFSITE
<b>Lecture Only</b>				
CPC-3	2.11	0.67	1.67	0.17
LC	2.50	1.20	1.20	0.38
CPC-3 & LC	2.21	1.08	1.31	0.23
<b>ISAL Only</b>				
CPC-3	3.25	2.00	1.00	0.38
LC	3.00	8.00	3.00	0.50
CPC-3 & LC	3.17	4.00	1.67	0.42
<b>Lecture and ISAL</b>				
CPC-3	2.40	1.20	1.40	0.23
LC	2.67	1.79	1.07	0.42
CPC-3 & LC	2.48	1.63	1.38	0.28

\*Note: Averages are unadjusted for the number of students in attendance at each lecture

**Table 3. Absolute and percentage totals of onsite lectures across all courses between STG and MAM lecture locations**

	STG	MAM	Percentage STG ONSITE (%)	Percentage MAM ONSITE (%)
<b>Lecture Only</b>				
CPC-3	46	3	94	6
LC	16	10	62	38
Total	62	13	83	17
<b>ISAL Only</b>				
CPC-3	16	2	89	11
LC	8	1	89	11
Total	24	3	89	11
<b>Lecture and ISAL</b>				
CPC-3	62	5	93	7
LC	24	14	63	37
Total	86	16	84	16

but asking a question while attending a lecture at the STG campus would count as a STG student asking a question and vice versa. It was not possible to take attendance at both sites for each lecture. Therefore, the number of questions asked per lecture was unadjusted for attendance at each location.

A question was defined as an instance where a student pressed the button at their desk, thereby being broadcasted across both auditoriums, to ask a question or respond to the lecturer. In nearly all instances, a student was asking a question rather than responding to the lecturer. An immediate follow-up question(s) was counted as part of the single initial question unless the student disconnected, pressed their button again, and was re-broadcasted. Such instances were rare. Questions that were asked out loud without being video broadcasted were not counted as questions in this study. Typically, there was zero to one question asked out loud per lecture. Question totals were counted for each didactic and ISAL lecture across both the CPC-3 and LC courses. To maintain consistency, two members of the research team independently counted each question asked across both courses and compared lecture totals at the end of the study. The protocol for differences in question totals for any lecture included having both researchers watch the lecture recording together to identify and clarify discrepancies. Fortunately, there were no inconsistencies between question totals between both researchers.

Question totals and averages were subsequently analyzed via unpaired, two-tail t-test using *GraphPad QuickCalcs t test calculator software*.<sup>11</sup> An unpaired, two-tail t-test was warranted due to the unequal number of lectures held at the STG location compared to the MAM location. A p-value <0.05 was considered statistically significant. An intra-campus comparison was used to examine differences in the average number of questions asked when lectures were onsite versus offsite across course type (CPC-3 and LC; CPC-3 only; LC only). Results from the CPC-3 and LC courses were used to investigate statistically significant variability between and within both courses. Given that each course was composed of both lectures and ISALs, and ISALs can have multiple lectures within their three-hour timeslot, the analysis compared the following lecture categories: *Lecture only*, *ISAL only*, and *Lecture and ISAL* (i.e. total lectures). An

ISAL with three lectures within it was counted as three individual lectures under the *ISAL only* and the *Lecture and ISAL* categories.

## Results

Our preliminary analysis examined the total number of onsite and offsite lectures and questions asked across each lecture category and course (Table 1), the corresponding average number of questions asked per lecture (Table 2), and differences in the average number of questions asked per lecture (Figure 1). A total of 102 lectures (86 at STG location, 16 at MAM location) yielded 239 questions by STG students (213 onsite questions, 26 offsite questions) and 46 questions by MAM students (22 onsite questions, 24 offsite questions). Although some students asked questions more frequently, overall there was no single group of students at either site asking most or all of the questions. When examining the CPC-3 and LC courses together, the difference in average number of questions asked per lecture was statistically significant across each lecture category for MAM students. In particular, MAM students asked 1.08, 1.25, and 1.10 more questions per onsite lecture than per offsite lecture for *Lecture only*, *ISAL only*, and *Lecture and ISAL* categories respectively (p-values of <0.0001, 0.01, and <0.0001 respectively). This represents an increase of 470%, 298%, and 393% more questions asked per onsite lecture than per offsite lecture, respectively. When examining the CPC-3 and LC courses together, the difference in average number of questions asked per lecture was not statistically significant across any lecture category for STG students. However, the pattern was similar between MAM and STG students. Specifically, STG students asked 1.13 more questions per onsite lecture in the *Lecture only* category (p-value of 0.09) reflecting an increase of 105% more questions asked per onsite lecture. STG students also asked 0.83 fewer questions per onsite lecture in the *ISAL only* category (p-value of 0.61). However, this result reflects eight STG questions asked in one of the two offsite *ISAL* lectures. Elimination of this potential outlier results in STG students asking 1.17 more questions during their *ISAL only* lectures (p-value of 0.53).

When examining the CPC-3 or LC course in isolation, the difference in average number of questions asked per lecture was statistically significant for MAM students across all categories with the exception of the *ISAL only* category (Figure 2). When examining the CPC-3 or LC course in isolation, the difference in average number of questions asked per lecture was not statistically significant for STG students across any category. However, it is notable that the *Lecture only* category (LC course) had a p-value of 0.06 which is just outside statistical significance. Overall these results are consistent with the finding that students at both campuses asked more questions per onsite lecture than per offsite lecture. The only exception to this was STG students asking more offsite questions in the *ISAL only* category in both the LC course in isolation and LC course combined with the CPC-3 course.

Each lecture category from one course was compared to the same category from the other course to investigate intra-campus variability between the CPC-3 and LC courses (Figure 3). The difference in onsite and offsite questions was not statistically significant for STG or MAM students across any category. Overall, these results suggest that MAM students were likely to ask the same number of questions per onsite lecture between the CPC-3 and LC courses and the same number of questions per offsite lecture between the CPC-3 and LC courses. This result also holds true for STG students.

The absolute number of lectures and corresponding percentage of lectures across each category and course were analyzed to determine if percentage of onsite lectures was consistent with class proportions (Table 3). The distribution of students, with 79% (205/259) at the STG campus and 21% (54/259) at the MAM campus, is slightly disproportionate to the percentage of onsite lectures across most lecture categories and courses. When combining both courses, the percentage of STG onsite lectures in the *Lectures only* and *Lecture and ISAL* category (83% and 84%, respectively) is comparable to the distribution of students at the STG campus. However, there were disproportionately more lectures hosted at the STG location during the CPC-3 course across these same categories (94% and 93%, respectively). This was balanced by an increased number of onsite lectures at the MAM location during the LC course across these same categories (38% and 37%, respectively). Moreover, there was a disproportionate number of *ISAL only* lectures hosted at the STG location across all courses (89% for each course).

## Discussion

### Main findings

This study found a generalized pattern of increased student participation when the lecturer is physically present than through distance learning. When comparing onsite to offsite lectures, MAM students asked 1.08, 1.10, and 1.25 more questions per lecture for *Lecture only*, *Lecture and ISAL*, and *ISAL only* categories, respectively (p-values of <0.0001, <0.0001, and 0.01, respectively) while STG students asked 1.13 and 0.85 more questions for *Lecture only*, and *Lecture and ISAL* categories, respectively (p-values of 0.09 and 0.19, respectively) and 0.83 fewer questions for the *ISAL only* category (p-value 0.61). There was no intra-campus variability between CPC-3 and LC courses suggesting that MAM students were likely to ask the same number of onsite questions during both courses and the same number of offsite questions during both courses. STG students were also likely to ask the same number of onsite questions between courses and offsite questions between courses. Additionally, although the total distribution of lectures at each campus was proportionate to the respective class size, there were disproportionately more lectures hosted at the STG location during the CPC-3 course and *ISAL* lectures. This was balanced by a disproportionate number of onsite lectures at the MAM location during the LC course.

This study raises questions of equity in educational exposure across campuses at the University of Toronto Faculty of Medicine. In particular, one can ask whether University of Toronto medical students participating in offsite lectures receive the same quality of educational experience as their onsite/in-person counterparts. It is interesting that students attending lectures at MAM are statistically more likely to ask questions when lectures of any category (*Lecture Only*, *ISAL Only*, and *Lecture and ISAL*) are onsite compared to offsite (p-values of <0.0001, 0.01, and <0.0001, respectively). STG students are also more likely to participate in onsite lectures, asking more questions than during offsite lectures across almost every course and category, though this finding was not statistically significant.

The correlation between lecture location and participation may be attributable to fear of embarrassment which may be improved by being in the same physical location as the lecturer. Students may not wish to draw attention to themselves or may fear appearing to have a weaker grasp on lecture material than their classmates.<sup>1</sup> Although

many medical students are intimidated by lecturers and experience impostor syndrome, their fears may be further amplified when being forced to ask questions virtually rather than in person.<sup>12,13</sup> In particular, onsite students can ask further clarifying questions in private during lecture breaks which could increase confidence to participate in subsequent lectures that day. Furthermore, lecturers may be able to develop better rapport with onsite students than with their offsite counterparts. Human presence and eye contact, elements that are not afforded in distance learning, may also decrease intimidation levels thereby increasing participation.<sup>5</sup> Eye contact between instructors and students helps build positive relationships, which in turn may help students be more emotionally and intellectually invested in class.<sup>14</sup> We believe that onsite vs offsite learning itself does not directly determine students' learning effectiveness. Rather, face-to-face learning versus distance learning influences participation which can affect students' learning effectiveness and satisfaction.<sup>15,16</sup> Future observational studies with student interviews would benefit by assessing such sentiments.

Potential solutions to this disparity in student participation are centered on eliminating distance learning. These include hosting all lectures within one, centralized, onsite auditorium or each campus hosting its own distinct, onsite lectures. Unfortunately, we are unable to quantify the impact of differences in educational experience and student participation as individual student test scores were unavailable. It seems unlikely that not being able to ask questions during lectures had a detrimental impact on student understanding for two reasons. First, there were very few questions asked per lecture (0.17-2.50 and 0.38-8.00 in the *Lecture only* and *ISAL only* categories, respectively) relative to the class size. Second, students had access to an online questions document where they could post questions related to all content leading up to the ISAL lectures. These online documents were monitored by the corresponding lecturers and were typically filled with dozens of student questions. The increased number of questions on these online documents, compared to those asked during lectures, could be attributed to students either feeling less embarrassed due to anonymity or having a stronger grasp of the medical concepts compared to during live lectures. Third, asking questions is a measure of student participation, which, if decreased, may also be decreased in other dimensions of student understanding not necessarily assessed in a multiple choice examination. This could thereby lead to a less effective overall learning experience. Future studies would benefit by not only directly comparing student test performance with the number of questions asked during lectures, but also by asking students if they feel they understand concepts more during an onsite lecture and remember them at later points throughout their medical school training.

## Limitations

There are several limitations to this study. First, the number of questions was used as a measure of student participation but not as a measure of value to student education. Unfortunately, our quantification is not a true reflection of how much students learned from each lecture and we were unable to compare student participation with assessment performance. For example, students who learn best by actively listening to the lecture content may absorb just as much knowledge as those who verbalize questions. Moreover, we simply examined the quantity of questions rather than the content of each question. It is difficult to assess which questions students

found to be more meaningful and beneficial to their learning experience. It is possible that one thought-provoking question was able to provide more clarity to students than more frequent, but straight-forward, questions.

Second, this study did not consider differences inherent to each lecture and lecturer. Lectures differ in complexity and amount of information. At the same time, some lecturers are more personable and inviting to questions. For example, one ISAL at the MAM location had eight questions asked by STG students. This offsite lecture was taught by a lecturer who is known to be personable and encourages student participation. Other lecturers indicate they are behind schedule and will not be answering questions during the lecture which discourages or prevents student participation. Interestingly, STG students asked slightly more questions per onsite lecture during the LC course than the CPC-3 course across the *Lecture only* category (Table 2). Difficulty of class material and/or students being more comfortable interacting with LC course lecturers could account for this pattern. One must wonder whether these patterns would change if every lecture was equally complex or all lecturers were equally personable and inviting to questions.

Third, attendance was not measured in this study. Consequently, the data is not adjusted based on physical attendance at each lecture. Differences in the number of students in attendance may shed more light on whether these patterns can be attributed to more students showing up for onsite lectures. Perhaps more questions were asked simply because of increased student attendance for onsite lectures. MAM students receive reminders encouraging them to attend onsite lectures each time a lecturer is scheduled to present at the MAM location. This email reinforcement may have played a role in increasing class attendance at the MAM location thereby increasing the number of questions asked per onsite lecture. Additionally, many ISAL lectures were mandatory but many MAM students live in downtown Toronto and can attend lectures at the STG location. A more rigorous data collection protocol, counting student attendance at each location, would be required to address this limitation.

Fourth, this study only collected information from one year of study. It is entirely possible that our findings are not applicable to previous or future second year medical students at this institution. Future studies repeating our data collection protocol would provide meaningful insight about the generalizability and repeatability of our findings.

It could be useful to repeat this study but with concurrent qualitative data collection from a sample of STG and MAM students after each lecture. Ideally this would elucidate why students have increased participation during onsite lectures. It would also be useful to determine how personable students find each lecturer and what role this has in having students be more comfortable with asking questions. In addition, it would be important to see if students value anonymity in asking questions and whether they would prefer to be able to type in questions that would appear on the lecturer's screen in place of having themselves publicly broadcasted across both campuses.

## Implications

Although this study was based on second year CPC-3 and LC courses at the University of Toronto Faculty of Medicine, these findings have broad implications once the COVID-19 pandemic is resolved. First, the pattern of increased onsite student participation

may be true for other years and courses in this medical school. While the impact on student learning has not yet been studied, it is an area that should be examined by faculty administrators and course directors. Second, other medical schools across Canada and around the world have a similar format of broadcasting a portion of their lectures to offsite locations and should therefore consider whether such patterns exist in their institutions. For example, the University of British Columbia Faculty of Medicine has four distinct campuses: Vancouver, Prince George, Victoria, and Kelowna.<sup>17</sup> Pre-clerkship lectures are live streamed across all four sites to enable distance learning. Just like students in this study, students at the University of British Columbia Faculty of Medicine can press a button in front of them to be broadcast across all four sites to ask a question. Third, non-medical academic institutions with distance learning must also consider whether such participation patterns exist and affect their students' educational experience. Finally, the COVID-19 pandemic has forced much of the world to switch to online lectures through platforms like ZOOM. Many students have been removed from the classroom and placed into a virtual environment. One must consider whether removing physical interactions with teachers may be stunting participation and educational growth. One must also question whether adult learners can benefit through the addition of online questions documents providing the anonymity required for students to ask questions without fearing embarrassment. The COVID-19 pandemic has placed many students into a virtual environment. This form of distance education carries inherent consequences and challenges similar to those experienced by medical students in offsite lectures. In the coming months, post-secondary educators must consider potential solutions to increase and maintain student participation despite removing physical interactions in a classroom. Once the COVID-19 pandemic has been resolved, medical schools must further investigate the impact of distance education on student learning and determine ways to ensure an equitable educational experience for all students.

## Conclusion

Medical students at both University of Toronto campuses ask more questions during onsite/in-person lectures than during lectures hosted at offsite locations. This pattern is statistically significant for MAM students across nearly all categories and courses but is not statistically significant for STG students. This finding raises the question of whether attending an offsite lecture will provide an impeded educational experience compared to attending an onsite lecture. This may disproportionately impact MAM students as the MAM campus hosts less than 20% of onsite lectures. Future observational studies will ideally provide more information about this difference in participation based on lecture location, its impact on student learning, and methods through which this can be alleviated. Future studies are also necessary to determine the generalizability of these results to other medical schools and educational institutions. Overall, this study will likely prove beneficial in helping course coordinators adapt curriculum changes once students return to a physical school environment after the COVID-19 pandemic.

## Conflict of interest

There are no conflicts of interest to declare. This project was unfunded. Klaudiusz Stoklosa and Christina Ding are medical students (Class of 2022) at the University of Toronto (St. George

Campus) who conducted this study and physically counted all student questions.

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