Using Point-of-View Wearable Technology as a Tool in Virtual Teaching Sessions to Supplement Clinical Skills Training: A Medical Student Perspective

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ABSTRACT

Introduction: The COVID-19 pandemic has forced many undergraduate medical programs to shift their preclinical curricula online, which has reduced student access to clinical skills sessions and caused gaps in students' knowledge.

Objective: This study sought to better understand the impact and role of virtual clinical skills training session using point-of-view (POV) live-streaming wearable technology to supplement medical students' learning.

Methods: 38 University of Ottawa medical students were recruited to participate in a 1.5-hour virtual clinical teaching session. An abdominal physical examination was broadcasted through two views (chest-mounted smartphone and room overview). Participants completed pre- and post-event questionnaires on their overall impression, satisfaction/challenges, and platform efficacy compared to other learning modalities.

Results: Differences were noted in participant engagement ($p=0.042$, Cohen's $d=0.48$), comparability to in-person encounters ($p<0.001$, Cohen's $d=0.75$), and confidence performing a physical exam ($p<0.001$, Cohen's $d=1.35$). Participants found the event was relevant to curriculum objectives (mean 4.55±0.69), engaging and interactive (mean 4.50±0.65), and reported good visualization through the broadcasted views (mean 4.61±0.59). All participants stated they were interested in attending similar sessions in the future.

Conclusion: This virtual clinical skill teaching session using POV technology was enjoyable and helpful in combating current COVID-related gaps in medical education. These results support the beneficial role of innovative virtual learning opportunities within medical school curricula. Future research should aim to evaluate the use of POV wearable technology in settings beyond the classroom.

RÉSUMÉ

Introduction: La pandémie de COVID-19 a contraint de nombreux programmes médicaux de premier cycle à transférer leur cursus préclinique en ligne, ce qui a réduit l'accès des étudiants aux sessions de compétences cliniques et a entraîné des lacunes dans les connaissances des étudiants.

Objectif: Cette étude visait à mieux comprendre l'impact et le rôle des sessions virtuelles de formation aux compétences cliniques utilisant la technologie vestimentaire de diffusion en direct du point de vue (PDV) pour compléter l'apprentissage des étudiants en médecine.

Méthodes: 38 étudiants en médecine de l'Université d'Ottawa ont été recrutés pour participer à une session d'enseignement clinique virtuel d'une heure et demie. Un examen physique abdominal a été diffusé à travers deux vues (smartphone monté sur la poitrine et vue d'ensemble de la pièce). Les participants ont rempli des questionnaires avant et après l'événement sur leur impression générale, leur satisfaction/problèmes et l'efficacité de la plateforme par rapport à d'autres modalités d'apprentissage.

Résultats: Des différences ont été observées au niveau de l'engagement des participants (p=0,042, d=0,48 de Cohen), de la comparabilité avec les rencontres en personne (p <0,001, d=0,75 de Cohen) et de la confiance dans la réalisation d'un examen physique (p <0,001, d=1,35 de Cohen). Les participants ont trouvé que l'événement était pertinent par rapport aux objectifs du programme (moyenne 4.55±0.69), engageant et interactif (moyenne 4.50±0.65), et ont rapporté une bonne visualisation à travers les vues diffusées (moyenne 4.61±0.59). Tous les participants ont déclaré qu'ils souhaitaient assister à des sessions similaires à l'avenir.

Conclusion: Cette session virtuelle d'enseignement des compétences cliniques utilisant la technologie PDV a été agréable et utile pour combattre les lacunes actuelles liées à la COVID dans l'enseignement médical. Ces résultats confirment le rôle bénéfique des possibilités d'apprentissage virtuel innovantes dans les programmes des écoles de médecine. Les recherches futures devraient viser à évaluer l'utilisation de la technologie portable PDV dans des contextes autres que la salle de classe.

INTRODUCTION

The COVID-19 pandemic has proven to be an obstacle to the provision of education to all students, particularly medical students across Canada who rely heavily on in-person sessions and clinical encounters. Many undergraduate medical programs responded to the pandemic by shifting components of their curriculum online due to safety mandates such as physical distancing.[1] In-person lectures, clinical programs, and patient encounters were replaced with online content such as pre-recorded videos and e-modules, or in some instances, suspended completely.[2] Challenges with virtual education have led to gaps in the current medical school curriculum.[3] Recent literature has discussed the rapid redevelopment of the medical curriculum in response to the COVID-19 pandemic, and calls have been made to develop innovations to deliver supplemental learning opportunities for medical students to address COVID-19-related gaps.[4-6] Before the pandemic, point-of-view (POV) learning and wearable technology proved to be an up-and-coming resource in healthcare and educational settings.[7] Lynch et al. described how POV video vignettes could be used to teach clinical skills to student paramedics, and Thomson et al. described how POV filming was effectively performed to successfully immerse fourth-year medical students in a ward simulation exercise.[8,9] Moreover, Teitelbaum et al. found that medical students preferred POV technology when compared to the third person view of pre-recorded videos followed by preceptor-led discussions.[10] As such, using POV-wearable technology provides promising potential as a tool for the training of medical students in our current virtual environment.

Previous literature has found that combining wearable live streaming devices with live video conferencing can replicate interactive learning environments that are comparable to in-person exposures.[3,7] Wintraub et al. evaluated several modalities of wearable technology and found the best device-accessory pairing for broadcasting virtual physical exams to be a chest-mounted smartphone using Zoom technology.[3,4] While wearable technologies appear useful in providing rich learning experiences in this study, it is important to build upon these findings and evaluate for generalizability and reproducibility at other educational institutions across Canada. The effectiveness, feasibility, and overall impact of POV filming on clinical skills development in medical students is an under-researched area.[4] As such, a clear need exists to expand upon the role of POV-wearable technology in medical education and to evaluate the perspectives of medical students on such technologies.

The remodeling of the undergraduate medical curriculum in the face of the COVID-19 pandemic continues to be a topic of interest among medical professionals and educators.[12,13] Our study aims to further investigate the effectiveness and feasibility of using POV-wearable technology as an adjunct to the University of Ottawa's clinical skills curriculum

(Physician's Skills Development (PSD) program) in order to simulate in-person learning experiences. Specifically, aiming to improve student engagement, bedside manner, and clinical competency. The goals of our study were to: (1) provide students with remote educational sessions to help mitigate the COVID-19-related gaps in the medical curricula and ensure students are achieving their core competencies; (2) engage participants as active agents in their learning by exploring their experiences and perspectives towards the use of POV technology in virtual education sessions; and (3) add to the growing literature of using wearable technology in medical education. Our research acts as a guide for those in charge of developing medical curricula or medical education researchers looking to improve upon the provision of virtual teaching sessions at their respective universities.

METHODS

Participants and Recruitment

This mixed methods study included two virtual clinical teaching sessions using POV wearable technology. Participants were University of Ottawa undergraduate medical students in their first, second, or third year. Students were recruited through local student-run associations (i.e., Family Medicine Interest Group, Aesculapian Society) via email and secure member groups. Interested participants self-enrolled by clicking on the link in the email and completing a form to register for the event. Thirty students were chosen to attend the event on a first-come first-serve basis and successful students were contacted via email. All other interested students were added to a waitlist in the case of a participant withdrawing. All participants, the tutor, and the standardized patient were provided with detailed information on the nature of the study, potential risks and benefits, and that they were free to withdraw from the study at any time. Participants were reassured that all efforts would be made to safeguard their personal information and ensure confidentiality be maintained. Consenting participants were provided preparation resources including information about the clinic skill being taught (i.e., abdominal physical examination) prior to the session. Participants were given the option to review the material beforehand to encourage active participation and discussion during the event. Ethics approval was obtained by the University of Ottawa's Research Ethics Board (REB #: H-09-21-7281).

Data Collection

As there were no suitable standardized and validated questionnaires available in the literature, two research assistance worked together to establish questionnaires using themes from current research as well as previous questionnaires used in relevant literature.[3,4,24] The questionnaires were reviewed for clarity and context by the two senior medical students, as well as one local family medicine resident, and two local family physicians with medical education experience. All questions were scored on a 5-point Likert scale with anchors ("Strongly Agree" to "Strongly Disagree"). Participants were asked to complete a brief pre-session survey one week before the event that described their concerns, comfort with, and expectations of the upcoming event. All participants took part in a 1.5-hour virtual teaching session that occurred via Zoom. The security of Zoom is acceptable for virtual clinical use by many hospitals associated with The University of Ottawa; nevertheless, participants were made aware of the minimal security risk inherent in its use before each event. During each session the tutor, a second-year family medicine resident from The University of Ottawa, used an iPhone 11 attached to a wearable chest strap to demonstrate an abdominal examination on a standardized adult patient. An additional camera was present during the examination to provide students with an alternate view of the exam and to optimize visualization. Participants provided verbal confirmation that all devices audio and visual were functioning properly. Physical distancing requirements and COVID-19 precautions were followed. Students were encouraged to interact with the tutor and ask questions using the microphone or Zoom chat message function. A research assistant facilitated the event and moderated the chat for questions in real-time. Immediately following the event, participants were emailed the post-event survey (Table 1) and given one week to complete it. Students were asked to elaborate on their overall impression of the technology, facilitators, and impact of the event. Events were recorded for future asynchronous learning opportunities and participants were made aware and provided written consent to this before commencing the session.

Data Analysis

All identifiable information was removed from the participant data, and it was stored on a secure, password-protected device. Two research assistants independently reviewed the data and means/standard deviations for each question were

calculated using Microsoft Excel. Participants' responses pre- versus post-event were compared via paired two-tailed t-tests to get a p-value and Cohen's d was completed to determine the relative effect size.[14] Researchers assessed effect size whereby values of 0.2–0.3 were considered small, 0.5 medium, and ≥ 0.8 large.[16] For this study, the p-value (<0.05) was evaluated in collaboration with the effect size to determine the overall significance of the intervention impact.[14] Research assistants collated participants' responses to the short answer questions into specific themes which were constantly assessed for accuracy and consistency throughout the research process.

RESULTS

Participant Demographics

Sixty medical students responded to recruitment and were sent the pre-event questionnaire to complete prior to the session. A total of 41 students (21 first event, 20 second event) attended the sessions and of these, 38 participants completed the post-event questionnaire. As such, the data from a total of 38 participants was evaluated (Figure 1). Medical student cohorts ranged from MD2025 (first-year students) to MD2023 (third-year students) with the majority of the 38 participants being in their first year of medical school (Table 2). Pre-event surveys were completed within one week before the event and post-event surveys were distributed immediately following the event and were completed within one week following the event.

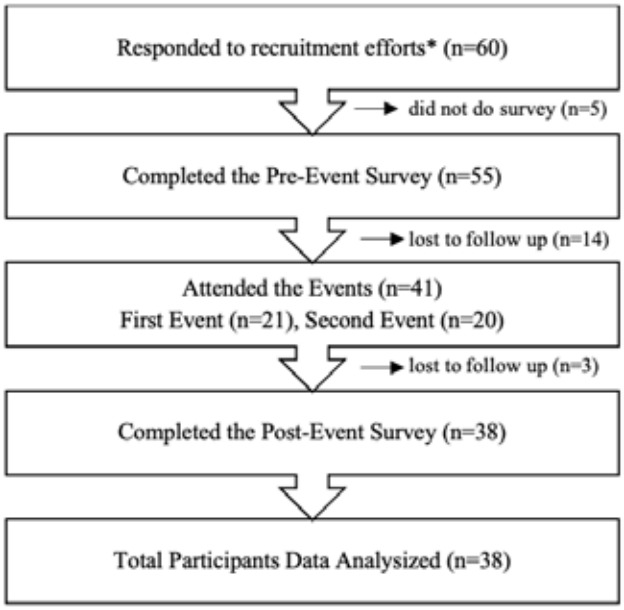

Figure 1. Participant Recruitment
Note: Participants were recruited on a first-come, first-serve basis with a maximum of 60 students

Participants' Perspectives of Virtual Learning Sessions

Participant responses pre- and post-event were compared using a 5-point Likert scale (Table 3). Participants reported significant changes with medium to large effect size in their confidence to perform a focused abdominal exam (2.63±1.15 pre-event to 3.95±0.77 post-event, p=<0.001, Cohen's d=1.35) and perceptions towards how the event compared to an in-person encounter (3.34±0.85 pre-event to 4.00±0.90 post-event, p=<0.001, Cohen's d=0.75). Of note, one participant reported that in some ways (i.e., visualization, interactions) the sessions were superior to in-person sessions. A significant difference with a nearly medium effect size was also reported in perspectives towards event engagement (4.58±0.68 pre-event to 4.87±0.53 post-event, p=0.042, Cohen's d=0.48). Overall, participants reported that the event was engaging and interactive (4.50±0.65), relevant to curriculum objectives (4.55±0.69), and that visualization was optimal (4.61±0.59). All participants agreed or strongly agreed that they were satisfied with the event and 31 participants (81.6%) agreed or strongly agreed similar events should be integrated into the pre-clerkship curriculum. Thirty-five participants (92.1%) agreed or strongly agreed that they were comfortable interacting with the tutor during the session and 36 participants (94.7%) agreed or strongly agreed that visualization of physical exam maneuvers was effective. Of note, all participants reported that they would be interested in attending a subsequent event focused on a different physical exam.

Session Strengths and Areas for Future Improvement

Participants were prompted to provide short answer responses on their experience of the event, what they found beneficial, and areas that could be improved. Participants' responses for both strengths and areas of improvement were collated into four major categories (i.e., video/audio, event organization, audience engagement, and curriculum integration; Table 4). Overall, participants enjoyed the session and found it beneficial for their learning. The most cited area for improvement pertained to audio quality. Despite this, participants supported the inclusion of similar sessions in their curriculum and preferred it over the physical examination videos that are currently used prior to PSD teaching sessions.

DISCUSSION

The COVID-19 pandemic has disrupted the traditional format of face-to-face training for medical students across Canada. In response, the rapid readjustment of the medical school curriculum has led to in-person activities (i.e., lectures, clinical duties, etc.) being suspended and replaced with virtual content in an attempt to fill these gaps.[2] Recent literature discussed the importance of using a "blended teaching" approach involving e-learning and traditional teaching methods to best improve medical student knowledge.[16] Wearable technology serves as an innovative adjunct and/or alternative to in-person teaching experiences in the current COVID-19 environment.[3,4,10] By using live video conferencing, our study aimed to investigate medical students' perspectives on the role of POV-wearable technology in simulating engaging, in-person learning experiences that successfully address medical education core competencies.

Participants' Perspectives of Virtual Learning Sessions

Given the current COVID-19 gaps in education, many educational institutions are working to improve their virtual teaching resources to provide quality education to students and to address core competencies.[18] Despite this, significant barriers to the adoption of e-learning by medical schools and concerns about the quality of education, particularly during preclinical medical training, exist.[19,20] Participants in this study reported that events were more engaging than pre-recorded videos, allowed for effective visualization of physical exam maneuvers, and improved confidence in performing an abdominal physical examination. Importantly, most participants found POV learning to be helpful and comparable to an in-person clinical skills session, and specifically 81.6% agreed that similar events should be integrated into the pre-clerkship curriculum. These perspectives align with findings from Wintraub et al. which suggest that chest-mounted smartphones are both an effective and efficient way of providing medical students with virtual POV physical exam demonstrations – particularly in the face of the COVID-19 pandemic.[3] Moreover, the findings echo those of Teitelbaum et al. who found that medical students viewed POV technology to be more engaging and ultimately improve knowledge retention when compared to pre-recorded videos followed by preceptor-led discussions.[10]

Prior to the event, participants reported feeling comfortable with the idea of learning in this nature, anticipated that they would enjoy the learning experience and that it would be beneficial for their learning. These high ratings are suspected to be related to students' limited exposure to physical examinations and a keen interest in learning. Findings from our study build on the evident pandemic-related gaps in medical education and showcase the strong desire of medical students to address these concerns. All participants were interested in attending subsequent sessions focused on a different physical examination and participants supported the integration of such events into the medical curriculum — reinforcing the interest and success of using POV wearable technology in clinical skills education.

The adoption of online learning will likely assume an important role in the teaching of medical students beyond the pandemic, including modalities such as mobile technology.[23,24] The additional application of online teaching methods within traditional medical education and career exploration can be anticipated nationwide as we continue to face the COVID-19 pandemic.[20,22] While these sessions cannot completely replace traditional face-to-face learning, our study supports blended learning methods (both virtual and in-person) which leads to better knowledge outcomes and translation compared to traditional learning.[10,25] Our study provides a framework for other Canadian medical schools to use and build upon. Considering the perspectives of participants in this study, this framework allows medical schools to capitalize on POV-wearable technology to address pandemic-related gaps in curriculum and provide high-quality, virtual learning opportunities for their students both amidst and beyond the current COVID-19 pandemic.

Session Strengths and Areas for Future Improvement

Participants reported feeling safe and comfortable interacting with the tutor and appreciated the use of a moderator to facilitate live questions. Similar to Teitelbaum et al. who found that two simultaneous views on a Zoom video call transformed the platform into a multi-perspective learning tool, our study suggests that a multi-camera perspective allows students to simultaneously visualize the physical exam and follow step-by-step explanations from the tutor.[10] Moreover, the virtual platform allowed tutors to effectively communicate with a greater number of students as compared to in-person small group learning sessions.

Event recordings provided students with the opportunity to review the session and engage in asynchronous self-learning. This closely aligns with existing literature which found that pre-recorded POV videos could enhance understanding prior to clinical application[17,25,26] and improve skills development within health education.[8,27] Several students expressed interest in substituting pre-recorded videos from the current medical curriculum with interactive sessions such as the one in this study.

Overall, students greatly valued the opportunity to learn with different modalities and these results highlight the role of live POV-wearable technology within the medical curriculum. Suggested areas of improvement include clearer audio quality, integrating knowledge after the session, and hosting sessions in concurrence with curriculum content. Participants' suggestions align with the understanding that the use of different mediums (i.e., classroom, virtual sessions) often leads to increased knowledge retention.[11]

Study Strengths and Limitations

Gathering feedback from students allowed this study to better appreciate medical students' perspectives and advocate for their involvement in discussions surrounding medical curricula. The reproduction of similar results across two events helps to strengthen the validity of our findings. The inclusion of a diverse student population (i.e., cohort, gender) contributed to the generalizability of the results. When interpreting the study, it is important to acknowledge its limitations. In this study, two major limitations included sample size and selection bias. The sample size (30 students per session) was selected to ensure participants felt comfortable interacting in a small group environment. During recruitment, several students were lost to follow-up, likely due to time conflicts, student over-commitment, or loss of interest. Despite this, our study had sufficient participants to achieve saturation regarding the usability and effectiveness of the teaching platform. Secondly, while the session was made available to all students within Ottawa's Faculty of Medicine, participants consisted mainly of first- and second-year students. This increased interest is likely related to the disproportionate impact COVID-19 has had on the clinical teaching of these cohorts. As such, these findings may not reflect the perspectives of all Canadian medical students. Moreover, participants volunteered for this study and were chosen based on a first-come, first-serve basis; possibly resulting in a selection bias for those students who were more keen or eager to learn. Lastly, participants' varying experiences in terms of their medical training (e.g., first-year, third-year) may have impacted their opinions towards the session's content, resulting in feedback that may not be based purely on the POV-wearable technology intervention.

CONCLUSIONS AND FUTURE RESEARCH

Overall, this study drew attention to the current COVID-19-related gaps that exist in medical curricula and demonstrated that POV-wearable technology is an accessible, innovative, and evidence-based tool to provide medical students with virtual clinical skills development sessions that address these gaps. Students appreciated additional clinical training experiences and viewed these live POV sessions as engaging alternatives to traditional physical examination sessions. By obtaining learner perspectives, our study integrated medical students as active agents in their learning and demonstrated their interest in participating in and receiving additional resources such as this to be implemented as a permanent tool. With the use of recordings, these sessions can be used as a longitudinal and asynchronous educational resource toward a blended learning approach for current and future medical students. The findings in this study serve as a strong foundation on which Canadian medical schools can build upon to incorporate virtual learning platforms into their medical curricula, to improve students' core competencies. Further research should look to build upon the findings by incorporating participant feedback (i.e., external microphone use, aligning events with curriculum) and increasing sample size and variability. Furthermore, future research should look to evaluate the use of POV-wearable technology in settings beyond the classroom (i.e., clinical observerships, procedural skills, rural medicine opportunities) given that virtual learning will likely persist as an adjunctive teaching platform in medical education beyond the current COVID-19 pandemic.

Conflicts of interest: None

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Table 1. Pre- and Post-Event Questionnaires

Pre-Event Questions	Post-Event Questions
Multiple-Choice 1. I am comfortable with the idea of learning clinical skills in this manner. 2. I will enjoy this learning experience. 3. This experience will be beneficial for my learning.EsP 4. Observing the patient interaction virtually will be comparable to observing an in-person clinical encounter. 5. This session will be more engaging than watching pre-recorded video vignettes for the same clinical skills. 6. I feel confident when it comes to performing a focused physical examination 7. I do not anticipate any problems with learning clinical skills from a virtual curriculum. 8. After this session, I will be confident in my ability to perform the clinical skills demonstrated. 9. Overall, I have high expectations for this learning session. 10. What do you hope to gain from this learning experience?	*Multiple-Choice* 1. After this session, I am comfortable with the idea of learning clinical skills in this manner. 2. I enjoyed this learning experience. 3. This experience was beneficial for my learning and improved my overall knowledge. 4. Observing the patient interaction virtually was comparable to observing an in-person clinical encounter. 5. This session was more engaging than watching pre-recorded video vignettes for the same clinical skills. 6. I feel more confident when it comes to performing a focused abdominal examination. 7. The content of the clinical skills session was relevant and clearly linked to course objectives. 8. I was engaged and felt comfortable interacting with the tutor during the session. 9. I was able to effectively visualize the physical exam maneuvers performed in this teaching session. 10. How would you rate your overall satisfaction with this teaching session? 11. How comparable is this learning experience to an in-person clinical encounter? 12. I think that virtual clinical teaching sessions, such as this, should be incorporated into the pre-clerkship curriculum? 13. Would you be interested in attending a subsequent session focused on a different physical examination?
Short Answer 1. What do you hope to gain from this learning experience? 2. What concerns, if any, do you have about learned this way?	*Short Answer* 1. Which elements of this clinical skills session did you like the most? 2. Which elements of this clinical skills session could be improved? 3. Please provide any additional comments, suggestions, or feedback for the research team/tutor or regarding the overall experience.

Note: For the multiple-choice questions, participants were required to select one answer that best described how they felt about the above statements. There were five answers, ranging from strongly disagree (1) – to strongly agree (5).

Table 2. Participant Demographics

	Participants	Lost to Follow Up	Total
n	38	17	55
Cohort	24 First Year 8 Second Year 6 Third Year	10 First Year 6 Second Year 1 Third Year	34 First Year 14 Second Year 7 Third Year
PG	8M, 30F	4M, 13F	12M, 43F

n=number of participants, PG=Perceived Gender, M=male, F=female

Table 3. Participant (n=38) responses to pre- and post-event questionnaires using a 5-point Likert scale

Questions	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean score ± SD	p-value Cohen's D
Q. After this session, I am comfortable with the idea of learning clinical skills in this manner.							
Pre-event	0 (0%)	0 (0%)	12 (31.6%)	12 (31.6%)	14 (36.8%)	3.97 ± 0.88	0.11
Post-event	0 (0%)	1 (2.6%)	3 (7.9%)	18 (47.3%)	16 (42.1%)	4.29 ± 0.73	0.40
Q. I enjoyed this learning experience.							
Pre-event	0 (0%)	0 (0%)	4 (10.5%)	11 (28.9%)	23 (60.5%)	4.50 ± 0.69	0.18
Post-event	0 (0%)	0 (0%)	0 (0%)	13 (34.2%)	25 (65.8%)	4.66 ± 0.48	0.27
Q. This experience was beneficial for my learning and improved my overall knowledge.							
Pre-event	0 (0%)	0 (0%)	0 (0%)	14 (36.8%)	24 (63.2%)	4.63 ± 0.49	0.83
Post-event	0 (0%)	0 (0%)	1 (2.6%)	13 (34.2%)	24 (63.2%)	4.60 ± 0.30	0.07
Q. Observing the patient interaction virtually was comparable to observing an in-person clinical encounter.							
Pre-event	0 (0%)	5 (13.2%)	18 (47.4)	12 (31.6%)	3 (7.9%)	3.34 ± 0.85	<0.001*
Post-event	0 (0%)	3 (7.9%)	7 (18.4%)	16 (42.1%)	12 (31.6%)	4.00 ± 0.90	0.75
Q. This session was more engaging than watching pre-recorded video vignettes for the same clinical skills.							
Pre-event	0 (0%)	0 (0%)	3 (7.9%)	10 (26.3%)	25 (65.8%)	4.58 ± 0.68	0.042*
Post-event	0 (0%)	1 (2.6%)	0 (0%)	2 (5.3%)	35 (92.1%)	4.87 ± 0.53	0.48
Q. I feel more confident when it comes to performing a focused abdominal examination.							
Pre-event	5 (13.2%)	16 (42.1%)	6 (15.8%)	10 (26.3%)	1 (2.6%)	2.63 ± 1.15	<0.001*
Post-event	0 (0%)	0 (0%)	12 (31.6%)	16 (42.1%)	10 (26.3%)	3.95 ± 0.77	1.35
Q. The content of the clinical skills session was relevant and clearly linked to course objectives.							
Post-event	0 (0%)	1 (2.6%)	1 (2.6%)	12 (31.6%)	24 (63.2%)	4.55 ± 0.69	—
Q. I was engaged and felt comfortable interacting with the tutor during the session.							
Post-event	0 (0%)	0 (0%)	3 (7.9%)	13 (34.2%)	22 (57.9%)	4.50 ± 0.65	—
Q. I was able to effectively visualize the physical exam maneuvers performed in this teaching session.							
Post-event	0 (0%)	0 (0%)	2 (5.3%)	11 (28.9%)	25 (65.8%)	4.61 ± 0.59	—
Q. How would you rate your overall satisfaction with this teaching session?							
Post-event	0 (0%)	0 (0%)	0 (0%)	15 (39.5%)	23 (60.5%)	4.61± 0.50	—
Q. I think that virtual clinical teaching sessions, such as this, should be incorporated into the pre-clerkship curriculum?							
Post-event	0 (0%)	3 (7.9%)	4 (10.5%)	10 (26.3%)	21 (55.3%)	4.29 ± 0.96	—

p-value <0.05=significant, Cohen's d = 0.2–0.3 small, 0.5 medium, and ≥ 0.8 large effect size

Table 4. Participant perspectives on the strengths and areas of improvement of events

Session Strengths	Areas of Improvement
Video/Audio	**Video/Audio**
"I really enjoyed the chest-mounted camera point-of-view. Great visualization (and sound) during percussion and inspection." "Having the multi-camera perspective was extremely beneficial as some features of the physical exam can be hard to see at a distance and the camera resolution was sufficient." "The camera set up was great - it was helpful to have the POV angle & the overview angle to see the doctor's perspective." "All parties involved seemed to know how to navigate the technology and the multiple views helped with the audio." "I really liked the camera that allowed us to see everything being done, as opposed to the stationary one."	"When the clinician was percussing the abdomen, we couldn't always clearly hear the sounds. Perhaps this could be fixed by using a microphone instead of using the camera microphone." "Perhaps providing the patient with a microphone so their voice is clear when responding." "The audience couldn't hear the percussion very well, perhaps a better microphone could pick up the sound differences with percussion better (i.e., tympanic vs. dull)." "Consider adding in sound effects of certain components such as percussion so students can better appreciate the sounds."
Event Organization	**Event Organization**
"I was grateful for the host reading questions out loud for everyone. Having moderator was useful to facilitate." "I really enjoyed the setup and organization of the session. Specifically, having small group interactive sessions created a safe and effective learning environment." "The event was a good pace and approachable format." "Dr. Horner was systematic and explained the steps of the physical exam clearly. As a first-year student it was helpful."	"Adding a mock case at the end would be great. I.e., having a patient with lower right quadrant pain and going through the DDx and special tests together to see how the physician uses their exam to make decisions and apply what we learned." "Talking about what you might write in the SOAP note for this patient would be great practice for pre-clerkship students." "Perhaps attendees could partner up and do different aspects of the exam and the tutor could give us live feedback."
Audience Engagement	**Audience Engagement**
"The resident was experienced and kind. I liked how interactive it was and how engaging and thorough his explanations were" "I really enjoyed how the resident took the time to walk us through the exam. I appreciated how he paused to let us assimilate and ask questions at various points." "The resident was informative/engaging (spoke to the camera, quizzed and encouraged students, great learning environment)." "I enjoyed that the session was occurring in real-time and that it was interactive. This provided the opportunity to ask questions."	"Consider online answering software to promote engagement." "Consider demonstration with a real-life patient encounter." "I felt the demonstrator was sometimes speaking a bit too fast. Consider slowing down the pace for better understanding." "We were unable to practice and get feedback from the physician which we likely would in person." "Consider a hybrid approach, where videos would be pre-recorded at high production value, and someone was there to answer questions and clarify."
Curriculum Integration	**Curriculum Integration**
"These sessions could replace the PSD videos students are asked to watch before in-person clinical sessions." "It was more engaging and helpful than pre-recorded videos." "I found the session very interactive and refreshing compared to the pre-recorded videos we watch for current PSD sessions." "In some ways, the angles were even better than in person (esp. in bigger groups) as we could all see the exam and there was no awkward shuffling trying to see what the tutor's doing."	"Hold future sessions on topics that students learn in first year. I would enjoy seeing exams that go along with the curriculum." "Send out the abdominal booklet a few days earlier to allow students additional time to review prior to the event." "Having a session on something already learned in class would be beneficial to better compare the two learning environments. "Referring to the PSD guide more frequently during the session would have helped orient the learners to the skill being taught."
Overall Impression	
"I would gladly learn more clinical skills this way, it is much better than the current PSD online lectures where we watch videos or look at images of the tests being performed." "Was incredibly well run and greatly appreciated. It was clear the team put in a lot of effort." "Two camera views were very helpful and are often lacking from faculty-run virtual clinical skills sessions." "I really enjoyed this event and would definitely do it again if offered." "For me personally I found this session very interactive, and it almost replaces in-person learning" "I enjoyed this session and got a lot from it. Looking forward to attending more in the future."	