Student perceptions on synchronous virtual versus face-to-face teaching for leader-centered and participant-centered postgraduate activities during COVID-19

Dinu S. Chandran, Simran Kaur, and Kishore Kumar Deepak

Department of Physiology, All India Institute of Medical Sciences, New Delhi, India

Abstract

Consequent to the unprecedented COVID-19 pandemic, pedagogic changes were introduced in postgraduate courses in Physiology, where face-to-face teaching was replaced with synchronous virtual mode for leader-centered (seminar, symposium) and participant-centered (journal club, group discussion) academic activities. We hypothesized that the effectiveness of virtual and face-to-face modes as perceived by postgraduate students in terms of facilitating their overall learning may differ across the spectrum of leader-centered and participant-centered activities. To assess the same, we designed and administered a comprehensive, structured, and validated feedback questionnaire. Postgraduate students (n = 29) rated virtual sessions significantly more convenient, but less attentive and comprehensible, and reported better audiovisual experience during face-to-face sessions. Students rated flexibility to attend, self-paced learning, ability to revise, lookup for information in real time, and accessibility to distant expertise as important features of virtual sessions and instant feedback, eye-to-eye contact, and ability to interact in the group for face-to-face sessions. Virtual and face-to-face sessions were perceived as equally effective in facilitating their overall learning for the conduct of leader-centered seminars and symposia. However, face-to-face sessions were considered more effective for the conduct of participant-centered group discussions and journal clubs. During the pandemic, students perceive the synchronous virtual mode as an equally effective alternative for the conduct of leader-centered academic activities, but face-to-face teaching is still preferred for the conduct of participant-centered academic activities.

COVID-19; e-learning; feedback questionnaire; medical education; postgraduate teaching

INTRODUCTION

Innovation in medical education is driven by societal necessities. The COVID pandemic has become a singular priority across healthcare and has affected medical education profoundly (1). Strategies like self-isolation, social distancing, and community lockdown led to an interruption in the conduct of “in-person” education (2–4). This could have detrimental effects on students’ well-being (2, 5). Thus, it was imperative to continue teaching to keep the students engaged (6). Consequently, several adaptations were made in the field of medical education to facilitate student learning and hence their well-being (7, 8). This also led to an inevitable pedagogic shift from conventional “person-to-person” didactics to online teaching during COVID-19 (9).

Virtual learning was considered as a potential method in undergraduate medical teaching even before the COVID era (10). Various medical educationists have innovated and compared the conduct of virtual versus live/face-to-face academic sessions (11, 12). In consonance, the majority of the researchers documented that there was no significant difference in effectiveness (with respect to increase in either students’ knowledge and/or performance) with virtual versus face-to-face methods of conduct (13, 14). Contrary to this, others emphasized that the students still preferred face-to-face conduct as their primary choice compared with synchronous or asynchronous virtual lectures (15, 16).

Students’ perceptions regarding the educational environment assist in the planning and implementation of a teaching strategy (17). Recently, the perception of undergraduate students was explored by Lima et al. through the use of synchronous and asynchronous online learning tools during COVID-19. The authors reported that the use of different online tools could help the students to inculcate dynamic learning and served as a source of motivation, especially during the period of quarantine (18). Singh et al. (19) also conducted a study on undergraduate students and reported that the majority of the students still preferred physical classroom teaching over e-platforms during the pandemic. Various other researchers also attempted restructuring of the curriculum using virtual strategies during the COVID pandemic (20, 21). Interestingly, to adapt to the changes in medical education due to COVID, third- and fourth-year medical students innovated and developed a comprehensive virtual COVID curriculum, which helped to create a better learning environment for themselves (22). As evident,
albeit the transition to virtual teaching has been explored in undergraduate courses, there is a paucity of literature on the effectiveness of virtual versus face-to-face academic sessions in postgraduate education during COVID-19.

Thus, contemplating the health risks posed by COVID-19, the Department of Physiology at All India Institute of Medical Sciences, New Delhi also embraced the transition to virtual platforms for the conduct of postgraduate activities. The postgraduate teaching program in the department is structured in such a way that it is a conglomeration of leader-centered and participant-centered academic activities. Leader-centered academic activities are speaker-driven activities in which the role of the other participants is voluntary and mostly limited to one-to-one interactions between the speaker and participant in response to specific trigger points or queries (seminars, symposia), whereas participant-centered activities are driven by the active academic interactions among participants in a cohesive and goal-directed way (group discussions, journal clubs) (23). The rapid transition to the virtual mode was more challenging for the instructors and the students, especially for participant-centered activities, where otherwise face-to-face interactions contribute to active learning (23).

Intrigued by the variations due to the differences in the level of interactivity and the role of the learner, we hypothesized that the effectiveness of virtual versus face-to-face mode of conduct, as perceived by the postgraduate students, in facilitating their overall learning may differ across the spectrum of leader-centered and participant-centered academic activities. The perception of the students remains one of the most accepted, cogent, and unfailing criteria to understand the learning experience of a given strategy (24) and helps us to gain insights regarding the sustainability of the newer strategies (19). However, there was an unavailability of validated questionnaires to assess the student’s perception of the effectiveness of virtual versus face-to-face conduct of postgraduate academic sessions. In addition, no prior study had reported the preferred mode of teaching (virtual vs. face to face) with respect to leader-centered and participant-centered activities.

Thus, the present study aimed to assess the student’s perception of virtual versus face-to-face conduct of leader-centered and participant-centered academic activities with respect to effectiveness, learning experience, and the preferred mode with a self-designed validated questionnaire.

**METHODS**

**Context and Setting**

Complying with the social distancing norms adopted in view of the health risks posed by COVID-19 to students and faculty, all scheduled academic activities of postgraduate students in the Department of Physiology, All India Institute of Medical Sciences, New Delhi were carried out exclusively in a synchronous virtual format using online meeting platforms from the third week of March 2020 until the end of April 2020. Before this transition, the academic sessions had been held exclusively in face-to-face mode since the commencement of the semester (January 1, 2020) during which the study was conducted.

**Study Design**

The study was observational and designed as a cross-sectional feedback survey to assess student perceptions about the effectiveness of face-to-face versus virtual mode of conduct of academic activities with a 26-item structured feedback questionnaire.

**Participants**

The postgraduate teaching program caters to ~25 postgraduate students pursuing the Doctor of Medicine (MD) in Physiology (3-yr postgraduate course after obtaining a basic medical degree) and the Master of Sciences (M.Sc.) Physiology (2-yr postgraduate course after obtaining a bachelor’s degree in life sciences/medicine/paramedical courses/dentistry) degrees. Participants included in the present study were postgraduate students in the Department of Physiology who had exposure to both face-to-face and virtual modes of conduct of academic activities and had attended at least 80% of the academic sessions conducted. The midterm obligatory switchover from face-to-face to synchronized virtual mode subjected the postgraduate students to ~30 h of academic sessions (consisting of seminars, symposia, journal clubs, and group discussions) conducted in virtual format for 6 wk. The total duration of exposure to conventional face-to-face conduct of academic sessions varied across the students depending on their year/semester of joining but was always >10 wk. The aforementioned group of postgraduate students pursuing M.Sc. and MD degrees in physiology thus transitioned from face-to-face to virtual instruction mode, thereby providing the opportunity to gauge and compare their perceptions during this obligatory shift. Attendance in all academic activities was compulsory for all postgraduate students except the MD students, who were posted on duty in COVID care facilities.

**Description of the Academic Activities**

The leader-centered academic activities were operationally defined as those in which one or more of the students (the speaker(s)) were assigned the responsibility to lead the session and deliver the academic content through didactic presentations while the rest of the learners participate and contribute voluntarily through their interactions in response to specific trigger points or queries arising during the presentation. This included seminars and symposia, whereas the participant-centered academic activities were those in which all learners were assigned equally important roles and responsibilities to participate and contribute to the learning process through active interactions as in group discussions and journal clubs. The details related to the frequency, duration, and description of each activity are provided in Table 1.

**Description of the Conduct of Virtual Sessions**

Synchronized virtual learning sessions were conducted with commonly available online meeting platforms. Briefly, students or faculty moderators created the invite link to attend the scheduled virtual academic sessions and circulated the same through e-mail a day before the date of conduct of the sessions.
Conduct of leader-centered sessions.
Attendees were instructed to mute their audio during seminars and symposia to minimize the interference from background noise and were asked to post their queries and comments in the chat box citing specific slide numbers to avoid unnecessary interruptions during the presentation but at the same time maintain a log of the queries raised at specific time points during the presentation. The speaker independently or as directed by the faculty moderator periodically addressed the queries posted in the chat box by discussing and interacting with the inquirer after introducing the query and its context to all attendees at predefined intervals or whenever it seemed to be appropriate without compromising the flow of the presentation.

Conduct of participant-centered sessions.
Interactive discussions during group discussions and journal club sessions were curated through the active involvement of the faculty moderator and senior demonstrator, who moderated the course of discussion based on previously set agenda or trigger points. Presentations by students individually or in small groups were an integral component of both journal club sessions and group discussions. Queries arising during the sessions posted in the chat box were taken up for discussion and were resolved at convenient intervals by the faculty moderator. The use of breakout rooms for small group activities was not a standard norm for the conduct of academic activities during the period of the study.

Design and Validation of the Questionnaire
Because of the lack of availability of an appropriate survey instrument, to address the study objectives a questionnaire was designed and validated, following the Association for Medical Education in Europe (AMEE) guidelines on developing questionnaires for educational research (25), which involved a six-step process as described below:

1. Conduct of literature review.
A literature review was performed by the investigators to define the construct and gain insights from similar studies in the past about the aspects to be addressed in the survey questionnaire.

2. Conduct of interviews.
Because of prevailing social distancing measures, inputs were obtained from a subset of student respondents \((n = 9)\) electronically through e-mail requesting them to provide their suggestions regarding the potential aspects they would consider to be relevant for assessing the effectiveness of virtual versus face-to-face academic sessions in Physiology for postgraduate students.

3. Synthesis of the literature review and interviews.
The aspects perceived to be important based on literature search and inputs received from respondents were synthesized by the investigators to reach a consensus regarding the construct.

4. Development of items.
Twenty-eight items were developed to address various attributes of the construct defined from the learner’s perspective, and the face validity of the same was established collaboratively among the investigators, who were faculty members with a minimum of 10 yr of postgraduate teaching experience. Items were categorized into six sections addressing different facets of the learner’s perception, comprising section I: feedback on various attributes of learning experiences; section II: feedback on presentation-related attributes; sections III and IV: perceived importance of features unique to face-to-face and virtual modes of conduct; section V: effectiveness of academic interactions in face-to-face versus virtual mode of conduct in facilitating the overall learning in various academic activities; and section VI: the preferred mode of conduct for various academic activities.

### Table 1. Description of leader-centered and participant-centered postgraduate academic activities conducted in the Department of Physiology, All India Institute of Medical Sciences, New Delhi

| Academic Activity\(^a\) | Frequency of Sessions | Duration per Session, h | Description of Activity |
|--------------------------|-----------------------|-------------------------|-------------------------|
| Leader centered          |                       |                         |                         |
| Seminars                 | Once a week           | 1.5–2                   | Seminars are academic presentations on fundamental subject topics prepared and delivered by a student speaker and moderated by a faculty member. |
| Symposia                 | Once every 4–6 wk      | 2–3                     | Symposia are academic presentations on broader topics/themes that are integrative and/or translational in nature, involving 3–4 speakers and moderated by a faculty member. |
| Participant centered     |                       |                         |                         |
| Journal clubs            | Once a week           | 1.5–2                   | Journal clubs are postgraduate academic sessions on published research papers moderated by a faculty member. Four-session format is being followed, in which initial 3 sessions are focused on in-depth understanding of the concepts, methodology, and critical appraisal skills related to the chosen article, followed by final presentation in the fourth session.† |
| Group discussions        | Once a week           | 1.5–2                   | Group discussions involve interactive discussions mostly on topics demanding conceptual clarity in which all participating students are expected to play an equally active role in academic discussion. Students are encouraged to raise questions, reflect on their understanding of the topic, and collaboratively build up their clarity on conceptualizing the topic through discussions moderated by a faculty member and senior demonstrator. |

\(^a\)The duration of the academic semester for the January–June 2020 session was 18 wk. †See Ref. 43.
5. Conduct of expert validation.

Content validity of the items was assessed by seven faculty experts from clinical and preclinical disciplines who had ≥3 yr of teaching experience as a faculty member. Experts rated each item in the questionnaire on a 4-point scale for 1) representativeness, 2) relevance, and 3) clarity. Analysis of the compiled ratings given to each item by the experts was performed by calculating the proportion of experts endorsing the content validity of that item regarding representativeness, relevance, and clarity, as described by Rubio et al. (26). Two items that did not attain the threshold scores for content validity were excluded from the questionnaire, and necessary modifications as suggested were incorporated wherever appropriate for items that were retained.

6. Conduct of cognitive interviews.

The revised questionnaire was shared with a subset of potential respondents (n = 5), and cognitive interviews were conducted by retrospective probing through telephonic conference calls involving two investigators and one respondent at a time to determine whether the items were comprehended and interpreted accurately as desired by the investigators. In the light of the responses obtained, items warranting revision were rewritten to ensure that they are comprehended and interpreted accurately.

Because of feasibility concerns imposed by the limited sample size, pilot testing of the validated questionnaire could not be conducted. The validated questionnaire consisted of 26 survey items listed under six sections (https://doi.org/10.6084/m9.figshare.13259105.v1). The terminologies used in the questionnaire with reference to the mode of conduct of academic activities are “web based” (to be considered as virtual) and “live” (to be considered as face to face).

Data Collection

After necessary ethical clearance was obtained from the institute ethics committee (Ref. No.: IEC-487/05.06.2020, RP-30/2020), the data were collected during the semester break, ensuring the anonymity of the respondents. The survey questionnaire, which consisted of the participant information sheet and consent form, was circulated electronically to 36 eligible participants through e-mail. Participants who did not respond in a week were sent a reminder as a follow-up e-mail.

Data Analysis

Internal consistency of items in various sections of the questionnaire was computed by estimating Cronbach’s alpha. Ordinal 5-point Likert scale ratings were converted to numerical scores ranging from +1 to +5, and 5-point bipolar scale ratings for items in section VI were assigned numerical values ranging from −2 through 0 to +2. Standard normality tests were used to assess the data distribution. Comparison of Likert scale scores between virtual and face-to-face sessions was done with the nonparametric Mann–Whitney U test. Comparison of the bipolar scale scores for the preferred mode of conduct across various academic activities was done by Kruskal–Wallis test followed by Dunn’s post hoc multiple comparison tests. Likert scale scores for the relative importance of features of virtual and face-to-face sessions (sections III and IV of the questionnaire) were compared against hypothetical median by one-sample Wilcoxon signed-rank test. All statistical tests were conducted with GraphPad Prism version 8.4.3 (GraphPad Software, San Diego, CA) and IBM SPSS Statistics version 27 (International Business Machines Corp.).

RESULTS

Of the 36 eligible participants, 29 postgraduate students of the department participated in the study, which translates to 80.5% response rate to the feedback questionnaires circulated through e-mail. Responses were received for all the items in the questionnaire from each participant. The data were found to be nonnormally distributed and are thus shown as median (25th–75th percentile).

Students provided feedback related to various attributes of learning experience on a 5-point Likert scale regarding both virtual and face-to-face conduct of academic sessions (section I). This section, consisting of seven survey items designed to gauge various aspects of learning experience, showed good internal consistency as revealed by Cronbach’s alpha of 0.822. The comparative analysis of Likert scale scores between virtual and face-to-face sessions for various attributes of the learning experience is as shown in Table 2. Virtual sessions were more convenient to be attended than face-to-face sessions [5 (4–5) for virtual vs. 4 (3–4) for face to face; P = 0.03], whereas students perceived that they were more attentive during face-to-face sessions [4 (4–5) for face to face vs. 4 (3–4) for virtual; P < 0.001] and found it easier to comprehend graphs and schematic diagrams during face-to-face sessions than virtual sessions [4 (3–4) for face to face vs. 3 (3–4) for virtual; P = 0.049]. Likert scores for the rest of the attributes were comparable between virtual and face-to-face conduct of academic sessions.

With reference to presentation-related aspects of academic sessions (section II), 48% (14/29) of attendees rated the audiovisual experience during face-to-face sessions better than that of virtual sessions, whereas 31% (9/29) considered them to be equal and 21% (6/29) of the attendees reported audiovisual experience during virtual sessions to be better than that of face-to-face sessions. Forty-five percent (13/29) of the attendees perceived that effective utilization of time was better in virtual sessions in comparison to face-to-face sessions, whereas 21% (6/29) reported it to be equally good and 34% (10/29) reported that effective utilization of time was better in face-to-face sessions than virtual sessions. This section of the questionnaire consisted only of two items, and the internal consistency as computed by Cronbach’s alpha was 0.654.

The questionnaire also addressed how important students perceived various features unique to virtual or face-to-face conduct of academic sessions in improving their overall learning through sections III (Cronbach’s alpha = 0.820) and IV (Cronbach’s alpha = 0.661) consisting of five and four survey items, respectively. The feedback was provided on a 5-point Likert scale. All the features of virtual sessions listed in the questionnaire were reported with a median Likert scale score ≥ 4, consistent with a rating of “quite important” or “extremely important,” which was statistically significant in comparison to the expected hypothetical median of 3 (1-
sample Wilcoxon signed-rank test). The features were: 3.1—Flexibility to attend the session from wherever you are [5 (3.5–5); P < 0.001], 3.2—Access to the video recording of the sessions facilitating learning at your own speed for a given presentation [4 (3.5–5); P < 0.001], 3.3—Ability to view video-recorded sessions more than once for revision [4 (3.5–5); P < 0.001], 3.4—Ability to look up information critical to the understanding of the concepts during the conduct of session [4 (3–5); P = 0.003], and 3.5—Accessibility to distant expertise from other departments/institutions [4 (3–5); P = 0.002].

Three of the four features of face-to-face sessions listed in the questionnaire, 4.1—Ability to give instant feedback on content and presentation [4 (3–4); P = 0.003], 4.2—Ability to have eye-to-eye contact and view gestures of the speaker [4 (3–5); P = 0.001], and 4.3—Ability to interact in a group [4 (3–5); P = 0.001], were reported with a median Likert scale score of 4, consistent with a rating of “quite important,” which was statistically significant in comparison to the expected hypothetical median of 3. The median score of one of the features of the face-to-face session, 4.4—Ability to view the slides with respect to one’s seating location, remained low at 3 (moderately important) and did not attain the level of statistical significance [3 (2–5); P = 0.25].

The survey also assessed how students perceived the effectiveness of academic interactions during various postgraduate academic activities conducted in face-to-face versus virtual mode in facilitating their overall learning on a 5-point Likert scale (section V). Median Likert scale scores for the effectiveness of academic interactions were comparable between virtual and face-to-face modes of conduct for leader-centered seminars [4 (3–4) for virtual vs. 4 (3–4) for face to face; P = 0.09] and symposia [3 (3–4) for virtual vs. 4 (3.5–4) for face to face; P = 0.11]. However, face-to-face sessions were reported to be significantly more effective than virtual sessions for the participant-centered journal club sessions [4 (3–4) for face to face vs. 3 (3–4) for virtual; P = 0.04] and group discussions [4 (4–5) for face to face vs. 3 (2–4) for virtual; P < 0.001]. The results are as depicted in Table 3. This section of the survey questionnaire reported good internal consistency, with the computed Cronbach’s alpha at 0.869.

Feedback was also sought on the student’s choice of the preferred method for the conduct of various academic activities on a bipolar scale as displayed in section VI of the questionnaire. This section of the survey questionnaire reported good internal consistency, with the computed Cronbach’s alpha at 0.869. The responses obtained are compiled and reported in Fig. 1A as the proportions of choices and in Fig. 1B as the bipolar scale scores obtained for each academic activity according to the choices made. The median bipolar scale scores derived by numerically coding the choices when compared across four academic activities revealed statistically significant difference only between symposia and group discussions [0 (−1 to 1) for symposia vs. −1(−2 to −1) for group discussions; P = 0.047; Fig. 1B].

### Discussion

Apropos to the unprecedented crisis of the COVID-19 pandemic, the present study was planned to assess the postgraduate student’s feedback on the effectiveness of virtual versus face-to-face conduct of leader-centered and participant-centered academic activities, in which variations occur with respect to the level of interactivity and the role of the learners. At the outset of the study, one of the lacunae was the unavailability of a feedback questionnaire aligned to the instructional strategies used for postgraduate teaching. During COVID-19, only a few questionnaire-based studies have assessed the effectiveness of e-learning and the preferences of students with a 5-point Likert scale (27, 28). Before the pandemic, researchers attempted to assess effectiveness based on the comparison of virtual conduct of lectures and face-to-face conduct based on Likert scales using items ranging from 9 to 16 (14, 15, 29). However, most of the studies

### Table 2. Likert scale scores of feedback on learning experience

| Item No. | Item Description | Virtual Session (n = 29) | Face-to-Face Session (n = 29) | P Value for Comparison |
|----------|------------------|--------------------------|-----------------------------|-----------------------|
| 1.1      | How convenient was it for you to attend? | 5 (4–5) | 4 (3–4) | 0.03* |
| 1.2      | How attentive were you during the sessions? | 4 (3–4) | 4 (5–5) | <0.001* |
| 1.3      | How easy did you find comprehending the graphs and schematic diagrams? | 3 (3–4) | 4 (3–4) | <0.05** |
| 1.4      | How comfortable were you to raise the queries? | 4 (2–4.5) | 4 (3–4) | 0.86 |
| 1.5      | How satisfied were you with the way speakers addressed most of the queries? | 3 (3–4) | 4 (4–4) | 0.06 |
| 1.6      | How effective were the sessions in encouraging you to take an initiative to learn by yourself? | 4 (3–4) | 4 (4–4) | 0.33 |
| 1.7      | How satisfied were you with the sessions in meeting your educational needs? | 4 (3–4) | 4 (3–4) | 0.18 |

Values are shown as median (25th–75th percentile). Five-point Likert scale scoring of the items: item 1.1: 1 = not at all convenient, 2 = slightly convenient, 3 = moderately convenient, 4 = quite convenient, 5 = extremely convenient; item 1.2: 1 = not at all attentive, 2 = slightly attentive, 3 = moderately attentive, 4 = quite attentive, 5 = completely attentive; item 1.3: 1 = not at all easy, 2 = slightly easy, 3 = moderately easy, 4 = quite easy, 5 = extremely easy; item 1.4: 1 = not at all comfortable, 2 = slightly comfortable, 3 = moderately comfortable, 4 = quite comfortable, 5 = extremely comfortable; item 1.5: 1 = not at all satisfied, 2 = slightly satisfied, 3 = moderately satisfied, 4 = quite satisfied, 5 = completely satisfied; item 1.6: 1 = not at all effective, 2 = slightly effective, 3 = moderately effective, 4 = quite effective, 5 = extremely effective; item 1.7: 1 = not at all satisfied, 2 = slightly satisfied, 3 = moderately satisfied, 4 = quite satisfied, 5 = completely satisfied. Mann–Whitney U test for comparisons between virtual and face-to-face sessions: *statistically significant; †unrounded P value = 0.0491.
activities conducted in face-to-face vs. virtual mode of academic interactions during various postgraduate

Table 3. Likert scale scores of perceived effectiveness of academic interactions during various postgraduate activities conducted in face-to-face vs. virtual mode

| Academic Activity | Mode of Conduct | P Value for Comparison |
|-------------------|----------------|------------------------|
|                   | Virtual (n = 29) | Face to Face (n = 29)   |                      |
| Symposium         | 3 (3–4)         | 4 (3.5–4)              | 0.11                 |
| Seminar           | 4 (3–4)         | 4 (3–4)                | 0.09                 |
| Journal club      | 3 (3–4)         | 4 (3–4)                | 0.04*                |
| Group discussion  | 3 (2–4)         | 4 (4–5)                | <0.001*              |

Values are shown as median (25th–75th percentile). Five-point Likert scale scoring of the items: 1 = not at all effective, 2 = slightly effective, 3 = moderately effective, 4 = quite effective, 5 = extremely effective. Mann–Whitney U test for comparisons between virtual and face-to-face sessions: *statistically significant.

either were conducted in undergraduates or assessed only lectures or used an asynchronous mode.

Thus, for the present study, a 26-item questionnaire sub-structured into six sections was designed and subjected to expert validation and sectionwise assessment of internal consistency by determining Cronbach’s alpha (25). The internal consistency was found to be excellent in four sections (I, III, V, VI) (>0.8) and relatively fair in two sections (II and IV) (>0.6) (30). Lower internal consistency in these sections may be related to fewer items, or the items may be measuring more than one construct (31). Thus, the scales were fit to assess the intended constructs as per the measures of content validity and internal consistency.

With reference to the learning experience, postgraduate students rated virtual sessions more convenient to attend compared with the face-to-face sessions, whereas more attentiveness and better comprehension of graphs and schematic diagrams were perceived during the conduct of face-to-face sessions compared with virtual sessions. All the other attributes (raising queries, queries addressed by the speaker, self-learning, meeting educational needs) were rated comparable during face-to-face versus virtual conduct of sessions. During the COVID pandemic, Singh et al. (19) assessed the perception of undergraduate students and documented that >50% of students preferred face-to-face over virtual sessions, although specific attributes were not looked at. Contrary to our study, Kaur et al. (28) reported that undergraduate students found e-learning-based sessions less convenient than regular classroom sessions. Similarly, Abbasi et al. (27) documented that despite virtual mode being the only option during the COVID pandemic, students did not prefer virtual mode, stating probable unpreparedness for the unanticipated shift. Before the COVID scenario, mixed results have been seen in the literature, where the majority support that virtual sessions are equally effective as face-to-face lectures (14, 32), whereas others preferred either face-to-face (33) or video-based lectures (29). The differences may be due to the asynchronous conduct, differential expertise of the instructors, differences in the nature of academic activities conducted, and the feasibility of controlled comparisons between face-to-face and virtual modes in these planned investigations, unlike the present study, which was circumstantially driven in the wake of the pandemic.

Regarding the aspects related to the presentation, the majority of the students rated better audiovisual experience during face-to-face sessions compared with virtual mode. This may partly be due to the drastic change to a newer virtual initiative, without prior training of the presenter as well

Figure 1. A: bar diagrams showing the preferred mode of conduct of sessions for various postgraduate academic activities. Numbers on the bars represent the number of responses received for each choice (n = 29). B: box and whisker plots showing median with 25th–75th percentile of the bipolar scale scores obtained for each academic activity according to the choices made with reference to the preferred mode (n = 29; *P < 0.05, based on Kruskal–Wallis test with post hoc Dunn’s multiple comparison test). Error bars are 1 sided when 25th percentile (seminars and journal clubs) or 75th percentile (group discussions) values are same as that of the median. Five-point bipolar scale scoring of the items: −2, Face-to-face session is the only choice; −1, Face-to-face session is preferred but virtual session as the second choice; 0, Face-to-face and virtual sessions are equally preferred; 1, Virtual session is preferred but face-to-face session as the second choice; 2, Virtual session is the only choice.
as the attendees (9). However, effective utilization of time was rated better in virtual sessions in comparison to face-to-face sessions. Previous studies have also reported that the online mode allows the learner more time to think critically and inculcate deeper understanding, but the presentation was asynchronous as opposed to the present study (34). Since both face-to-face and virtual conduct have multiple attributes that can influence learning, comparison to one another may overshadow the advantage of either of them. Thus, we asked the students to rate how important the characteristic features of either mode were to facilitate their overall learning. We found all the listed features for virtual conduct of sessions (flexibility to attend, self-paced learning, ability to revise using recorded sessions, lookup for information, and accessibility to distant expertise) were rated important by the students. Huynh (35) reported that e-learning gives flexibility to medical students over content and pace and can foster self-directed learning. Contrary to our study, Kaur et al. (28) documented that e-learning did not stimulate students’ learning needs even during the scenario of COVID. Furthermore, three of the four features of face-to-face sessions, viz. ability to give instant feedback, ability to have eye-to-eye contact and view gestures, and ability to interact in a group, were reported to be important according to the students. Mogwe (36) reported that real-time interaction and feedback during lectures give students a sense of control over their learning. In addition, students perceive that face-to-face interaction augments a sense of community and strengthens their confidence (37).

To create a favorable learning environment, it is imperative to study the students’ perception of various methods implemented (38). Thus, students were asked to rate the effectiveness of face-to-face versus virtual conduct of academic activities to improve their overall learning. Interestingly, the effectiveness of face-to-face versus virtual mode of conduct was comparable for leader-centered seminars and symposia. During COVID, Sandhu and de Wolf (39) reported that online webinars could engage undergraduate students well. Contrary to this, Abbasi et al. (27) reported that undergraduate students did not prefer e-lectures over face-to-face during the pandemic. Journal clubs are participant-centered activities with a focus on adult learning principles, critical appraisal skills, and interactivity (40). Conventionally, journal clubs are conducted through face-to-face interactions (41), but innovations have been done related to virtual and live conduct of journal clubs (42, 43). Furthermore, in the present study, we found that the postgraduate students perceived that face-to-face conduct of journal club sessions enhanced their academic interactions, which could facilitate overall learning as compared to the virtual format. Chan et al. (42) reported that online journal club sessions are flexible but pose difficulties in engaging large audiences, whereas McLeod et al. (44) found that face-to-face journal club was more effective than online for inculcating critical appraisal skills. Akin to journal clubs, group discussions also followed a similar trend in the present study, with clearer demarcation in the Likert scale scores (Table 3). Some researchers have reported that online group discussion lacks effectiveness because of the absence of nonverbal cues, which are important for student-teacher interactions (45).

Because of the paradigm shift from teaching to an emphasis on learning, there has been change in the focus from a teacher- to a student-centered approach (46). Since the drastic transition to virtual conduct was a “new normal” for medical education during the pandemic, it stimulated us to assess the perception of students regarding their preferred mode for conducting various academic sessions, viz face-to-face versus virtual, with respect to the various academic activities. It was observed that the preference for group discussions clearly aligned toward the face-to-face mode of conduct, with a negative median bipolar scale score that differed significantly from that of the symposium (Fig. 1B). This reinforces the challenge of using a virtual format for group discussion, which is considered a means to inculcate self-directed learning, communication skills, and student-faculty and peer-peer interactions (47).

The postgraduate students perceived that face-to-face interactions were more effective to facilitate their overall learning for the journal club sessions. However, surprisingly, when we looked into the preferred mode for the conduct of journal clubs, the preference for face-to-face mode was not apparent. This may be attributable to the characteristic format of conducting journal clubs in the department, which consists of three sessions of participant-centered discussions of the respective paper followed by the final presentation of the paper in a leader-centered format during the fourth week (43). Therefore, the students’ choices for the preferred mode of conduct for journal club sessions might have been influenced predominantly by the leader-centered nature of the final presentation, resulting in a response profile aligning better with that of seminars and symposia than that of group discussions as anticipated.

Since the transition to virtual mode was challenging for the instructors as well, use of additional innovative tools like breakout rooms was not employed for most of the sessions; which might have otherwise provided a richer and more interactive learning environment during the conduct of online activities and might have altered the findings of the present study. Along similar lines, in our recent study, we also found that adopting an innovative structured approach toward the conduct of virtual group discussions (sVGDs) in the wake of the COVID pandemic could effectively circumvent the pitfalls of conventional virtual group discussion (23).

To the best of our knowledge, this is the first study to comprehensively assess the perception of postgraduate students on the effectiveness of synchronized virtual versus face-to-face conduct for a diverse spectrum of postgraduate academic activities, using a multifaceted 26-item self-designed validated questionnaire with good internal consistency. Additionally, the study describes a plethora of factors to be kept in mind before planning and choosing the appropriate format for an effective conduct of participant-centered and leader-centered academic activities. Ascertaining feedback from the same student cohort who transitioned from face-to-face to virtual format adds to the reliability of the study findings.

However, these findings are limited by the small sample size of the volunteering postgraduates in a specific department of a single academic institution and may not be applicable to other student cohorts. Because of feasibility
concerns imposed by the limited sample size, pilot testing of the validated questionnaire could not be conducted. The inevitable rapid transition may have led to administrative constraints for the instructors in terms of careful planning, designing, or modifying the content suitably aligned to the learning objectives of the students using the virtual mode. Since the students’ perceptions were against the backdrop of online being the only option available and no objective performance indicators were taken for the present study, the results may not accurately reflect their learning gains (48). Thus, although all these factors could alter the perception of the students, the authors perceive that for institutions like ours, where the transition to online teaching was obligatory with limited prior exposure, it was imperative to take student feedback in order to strategize and develop the best practices.

To conclude, we found that during pandemic or similar unforeseen circumstances, postgraduate students perceive synchronous virtual mode as an equally effective alternative for the conduct of leader-centered seminars and symposia. However, the face-to-face mode is still preferred for the conduct of participant-centered journal clubs and group discussions. The present study provides insights into the perspective of students in academic settings relying on synchronous virtual mode as the sole replacement for face-to-face sessions in response to the COVID pandemic or similar unforeseen circumstances and potentially can be translated to other academic courses and student cohorts. It also paves the way for redesigning the courses using a hybrid mode for an efficient academic delivery after the pandemic is over.

### ETHICAL APPROVALS

As per Ref. No. IEC-487/05.06.2020, RP-30/2020, dated 18th June 2020, ethical approval has been granted by the Institute Ethics committee, All India Institute of Medical Sciences, New Delhi.

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### DISCLOSURES

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

### AUTHOR CONTRIBUTIONS

D.S.C., S.K., and K.K.D. conceived and designed research; D.S.C. and S.K. performed experiments; D.S.C. and S.K. analyzed data; D.S.C. and S.K. interpreted results of experiments; D.S.C. and S.K. prepared figures; D.S.C., S.K., and K.K.D. drafted manuscript; D.S.C., S.K., and K.K.D. edited and revised manuscript; D.S.C., S.K., and K.K.D. approved final version of manuscript.

### ENDNOTE

At the request of the authors, readers are herein alerted to the fact that additional materials related to this manuscript may be found at https://doi.org/10.6084/m9.figshare.13259105.v1. These materials are not a part of this manuscript and have not undergone peer review by the American Physiological Society (APS). APS and the journal editors take no responsibility for these materials, for the website address, or for any links to or from it.

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