Original Article

Changing paradigms in anatomy teaching-learning during a pandemic: Modification of curricular delivery based on student perspectives

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الموجه ذاتيا الطلاب على بقائهم متحمسون للتعلم. وخلصت الدراسة إلى أن التدريس عبر الإنترنت يجب أن يصمم بحيث يضع ملاحظات الطلاب في الاعتبار وأن يكون مصمما ليناسب احتياجات التعلم للطلاب.

الكلمات المفتاحية: علم التشريح؛ كوفيد-١٩؛ التغذية الراجعة؛ التعلم؛ التعلم عبر الإنترنت؛ طلاب الطب

الملخص

أهداف البحث: تم تصميم هذه الدراسة لاستكشاف تصور الطلاب للتغييرات التعليمية الرئيسية والتحديات التي واجهوها أثناء الوباء وفيما يتعلق بفعالية تدريس علم التشريح عبر الإنترنت. تم استخدام ردود الفعل من الطلاب في إصلاح الجلسات عبر الإنترنت في علم التشريح وجعلها أكثر جاذبية.

طرق البحث: شملت هذه الدراسة القائمة على الملاحظة ٢٥٠ طالبا من طلاب السنة الأولى بكلية الطب الذين حضروا فصول علم التشريح عبر الإنترنت خلال الوباء. تم تصميم استبانة جزئية الهيكلة للحصول على إجابات الطلاب. وشملت: طريقة / ساعات التفاعل، والعوامل الميسرة / المعوقة، والنهج العملي، والتقييم في تدريس علم التشريح عبر الإنترنت. تم التعبير عن النتائج الكمية بالنسب المئوية. تم استخدام تحليل التباين أحادي الاتجاه لتحليل أسئلة الترتيب. تم إخضاع الأسئلة المفتوحة للتحليل النوعي وتم تحديد المواضيع.

النتائج: أظهر عدد الساعات التي تم قضاؤها في جلسات عبر الإنترنت يوميًا زيادة خلال الوباء. غالبا ما تفاعل الطلاب مع أقرانهم (العدد = ١٢٤) من خلال وسائل التواصل الاجتماعي (العدد = ٩٧) لتوضيح الاستفسارات. اختار الطلاب التعلم من خلال كلا الوضعين غير المتزامن (٥٥ %) والمتزامن (٤٥ %). كما حدد التحليل النوعي الموضوعات التالية تحت الفئات التالية: عوامل التيسير، والعوامل المعيقة والتدابير المتخذة للتغلب على العوامل التي تعيق تعلم علم التشريح عبر الإنترنت.

الاستنتاجات: يجب أن يكون هناك توازن بين طرق التدريس المتزامنة وغير المتزامنة لتوفير وتيرة تعلم أفضل. سيساعد دمج المزيد من استراتيجيات التعلم

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Abstract

Objectives: This study is designed to explore students' perception of major educational changes and challenges encountered during the pandemic, as well as the effectiveness of Anatomy online teaching. Feedback from the students will be utilized to reform the online sessions in Anatomy, and make them more engaging.

Methods: This observational study includes 250 first-year undergraduate medical students attending online Anatomy classes during the pandemic. A semi-structured questionnaire was designed to seek student responses, including mode/hours of interaction, facilitating/hindering factors, and assessment in online teaching. The quantitative findings were expressed in percentages. The open-ended questions were subjected to qualitative analysis, and themes were identified.

Results: The number of hours spent on online sessions per day showed an increase during the pandemic. Students most often interacted with peers (n=124) through social media (n = 97) to clarify queries. Students opted for both asynchronous (55%) and synchronous modes (45%) of learning. The qualitative analysis identified the following thematic categories: facilitating factors, hindering factors,

and measures taken to overcome hindering factors in online learning.

Conclusion: There should be a balance between synchronous and asynchronous teaching methods to provide a better learning pace. Incorporation of more self-directed learning strategies would motivate students to learn better. The study concludes that online teaching should be designed to keep student feedback in mind, and tailored to suit student learning needs.

Keywords: Anatomy; COVID-19; Feedback; Learning; Medical students; Online learning

Introduction

The advent of COVID-19 has created havoc, endangering lives, and disrupting lifestyles worldwide.[1] Its impact on the education system has also not gone unnoticed.[2] In particular, the pandemic caused significant changes to higher education globally, necessitated by social distancing measures preventing face-to-face teaching.[3] Higher education institutions were forced to make an almost immediate switch to distance learning.

Medical schools were no exception; compelled to stop routine teaching methods as a preventative measure, they also resorted to online teaching. Owing to the uncertainty in resuming regular teaching sessions, they have continued to conduct online classes.[4]

Anatomy is often regarded as the 'foundation of medical sciences'.[5] However, it is also perceived to be a challenging subject in medical education.[5,6] Intrinsically, Anatomy is a three-dimensional subject requiring a sound understanding of the relationships between structures, often achieved by studying human cadaveric material, models, and microscopic resources. This practice lagged during the pandemic, with online teaching the only way to meet learning needs.

Different online teaching platforms were used to educate students. Various technological innovations came into practice in imparting Anatomy education,[7] and teachers attended faculty development webinars to hone their skills in using the online teaching model.[4,8]

Educational practices before the pandemic, and our Institute's existing anatomy curriculum: Located in Southern Asia, our medical school takes in 250 undergraduate students every year. The MBBS course is of five and a half years, including one year of internship. The first-year undergraduates are taught Anatomy for 13 months, through a systemic approach consisting of General, musculoskeletal, cardio-respiratory, gastrointestinal tract, renal, nervous, endocrine, and reproductive systems. One-third of the teaching hours include didactic lectures, while two-thirds of the teaching methods involve cadaveric demonstrations, histology practicals, and small group teaching. We have a learning management system (LMS), 'EduNext,' (Edunxt Technologies Pvt Ltd. Noida, Uttar Pradesh, India), which is used to upload the class PowerPoints, conduct formative assessments (FA) and quizzes, and announce student assignments.

Our undergraduate students get early clinical exposure through hospital visits, during which they can interact with clinicians and discuss cases through videos, simulation, or through patients. The academic year starts in August, with a month-long foundation course. Students have FAs at least once a week, and continuous assessments once a month, and at the end of each organ system. They also have three sessional examinations.

Paradigm shift in anatomy teaching-learning due to the pandemic: Anticipating the extended lockdown during March 2020, we arranged to switch to an online mode of teaching, starting with online lectures. The faculty underwent training programs to acquaint themselves with the online teaching platform 'Microsoft Teams.'

At first, we started with the online lecture classes in synchronous mode without practical demonstrations. The synchronous lecture classes were the duration of one hour, during which the teacher and the students were online. The students could access these recorded online classes through 'Microsoft Stream' and the class PowerPoints through the LMS, so that they could learn in an asynchronous mode even after the live online session.

Further, we reinforced the lecture classes through videos and illustrations by providing access to the 'Clinical Key student' (Elsevier) and sharing e-books and atlases. However, students were still deprived of live cadaveric demonstrations, though we had provided them numerous multimedia resources.

Despite all the efforts made to teach Anatomy online, the following concerns remained: 'How effective are these online platforms in meeting students' learning needs in anatomy, which involves faculty and student interaction when it comes to dissection, histology, etc.?' 'How are the students dealing with the current teaching scenario? Are they facing any technical hardships?' 'What modifications could be incorporated into the online teaching curriculum to make it more effective?"

Therefore, the present study was designed to explore student perceptions of major educational changes and challenges encountered during the pandemic, and regarding the effectiveness of teaching-learning Anatomy courses online.

Materials and Methods

Study design

This observational-cross sectional study involved 250 first-year undergraduate medical students from the authors institution who learned Anatomy online during the COVID-19 pandemic, from June to October 2020. The students' perceptions about online Anatomy teaching-learning was sought at a single time point, i.e. the end of

October 2020. The students were in their hometowns during the pandemic, and considering the poor response rate and difficulty in following up with them, we decided to obtain student perceptions at only one point of time. Upon the Institutional Ethics Committee (IEC338/2020) approval at Kasturba Medical College Manipal, the questionnaire was administered to the students after obtaining their informed consent (as mentioned in the first page of the questionnaire). The students agreeing to fill the questionnaire was considered as their voluntary participation in the study.

Data collection

A semi-structured questionnaire containing both closed and open-ended questions was designed and administered using an online platform, Microsoft office forms®, to seek student responses on the effectiveness of Anatomy teaching-learning online (Annexure 1). The students' were invited to fill the questionnaire via e-mail. A link and a QR-code were generated and circulated among the students to access the questionnaire. They were given one week to answer. The convenience sampling method was used.

The questionnaire comprised 39 questions in four sections. The time required to answer these questions was approximately 15 minutes.

The sections included were demographic details (age, gender, locality, country of residence), Anatomy-online learning (number of hours spent, mode/hours of interaction, facilitating/hindering factors, etc.), and online practical classes.

The following types of questions were used: choices, rating (visual analogue scale), ranking, and open-ended. The open-ended questions mainly focused on the facilitating and hindering factors for online learning, and ways students have tried to overcome the hindering factors.

The questionnaire content was validated using a validation checklist using a scoring of 0–4 for relevance, clarity and practicability by two internal faculty members from the researchers' institution, and one external faculty member from an institution abroad. The validators were all actively involved in online Anatomy teaching.

Data analysis

The demographic details were noted. Further, student responses were segregated into categories using Factor Analysis wherein we expressed both quantitative and qualitative findings.

Quantitative analysis

The quantitative results were expressed in frequency and percentages for categorical variables. The reactions for the visual analogue scale (VAS) ranged from 0 to 10, and they were further categorized as detractors, i.e., did not prefer (0–6), passives, i.e., managed to adjust,[7,8] and promotors, i.e., found it easy[9,10] by the programming software of Microsoft Forms. We used one-way ANOVA

for analysing the ranking questions, i.e., for continuous variables. We expressed the results as mean and standard deviation. IBM-SPSS version 21 was used for statistical analysis.

Qualitative analysis

The student responses obtained for the open-ended questions were coded for qualitative analysis, and we identified themes. The participant responses were made into written scripts. The authors then read and re-read the written scripts, and coded the information. Further, the codes were studied to identify patterns and themes. The data was coded manually, and an inductive and semantic approach was followed for the thematic analysis. Student feedback was utilized in reforming and making the online sessions more engaging.

Results

Sample characteristics

Out of 250 students, 169 responded to the survey (response rate 67.6%; 80 males and 89 females). The age of the students ranged from 18 to 22 years.

Among the 169 respondents, 160 students were at home, while the remaining nine stayed back in the hostels. India was the country of residence during the lockdown period for most students (n = 157). The remaining 12 students were in the Middle East. The locality of stay was urban for 143 students, and rural for 26 students.

Categorization of student responses

The student responses were categorized according to the factor loadings in factor analysis. We identified the following five categories:

1. Utilization of online platform for learning

When asked about the congeniality of learning Anatomy online, we obtained a mean rank of 5.14 ± 2.16 (promotors-9, passives-39, and detractors-180) (range 0–10). The students gave Microsoft Teams Platform's usage for online learning a mean rank of 5.99 ± 2.34 (promotors-19, passives-60 and detractors-88) (range 0–10).

2. Interaction and learner engagement

Differences in the number of teaching hours before and during the pandemic on online learning, self-study, and interaction with teachers/peers are displayed in Figure 1. The number of hours spent on online Anatomy sessions per day showed an increase during the pandemic. The number of hours utilized in self-learning Anatomy showed a difference, with very few students spending long hours learning during the pandemic. The hours of interaction with teachers and peers also considerably reduced during this period.

The mean rank for the question 'After an online Anatomy session, do you interact/discuss?' was 4.18 ± 2.45 (promotors-4, passives-30 & detractors-136) (range 0−10). 'Student interaction' involved interacting with peers 73.3% (N = 124), teachers 26.6% (N = 45), and seniors 2.9% (N = 5). Social media was the most typical mode of interaction 57.3% (N = 97), followed by telephone 34.3% (N = 58) and other online tools 8.2% (N = 14).

3. *Feedback on the pattern of teaching during the pandemic*

Regarding subject understanding with only the online lecture classes and no practical sessions, a mean rank of 3.78 ± 2.19 (Promotors-3, passives-18 and detractors-149) (range 0−10) was obtained. While 119 (70%) students wanted to have online practical classes, the remaining 51 (30%) disagreed. The majority of the students wished to have live demonstrations (n = 109, 59%), while others (n = 72, 39%) opted for recorded videos. Students ranked Histology as the most difficult topic to learn online using a 1−4 ranking scale (3.08 ± 1.21), followed by Neuroanatomy (2.22 ± 1.14), Embryology (1.92 ± 1.07), and Gross Anatomy (1.80 ± 1.12). One-way ANOVA revealed significant differences between all the topics mentioned above. Alpha = 0.05 was used to assess significance of tests performed.

4. *Preferred learning strategies*

For learning Anatomy, 55% (n = 93) students preferred accessing recorded lectures, and 45% (n = 77) liked live online lectures. Students found it difficult to clarify their queries during online lectures compared to the traditional classroom setting (Promotors-13, passives-41 and detractors-115). They also found it challenging to learn through a self-directed approach (Promotors-15, passives-49, and detractors-102).

When asked to rank the preferred type of learning resources using a 1−3 ranking scale, students ranked textbooks first (1.88 ± 1.08), followed by online resources (1.68 ± 1.10), and resources provided by the Institute (1.48 ± 0.91). One-

way ANOVA did not reveal any statistical significance between these three choices.

During the pandemic, live video demonstrations by the faculty were preferred by 120 (38%) students as the best alternative option to learn Anatomy effectively. The students also opined that recorded videos by the faculty (99, 31%) and videos available online (96, 30%) would be the other alternatives.

The students found online quizzes extremely useful for learning 65% (N = 110), followed by online group activities 28.4% (N = 48); 98 (57.9%) students agreed that practice quizzes made available online had helped them learn better. However, 84 (49.7%) preferred the gradable end-block MCQ tests, and 62 (36.6%) chose quizzes during online classes. Regardless, the students were not supportive of making such examinations a mandate in teaching Anatomy (Promotors-16, 9.4%, passives-41, 24.2% and detractors-109, 64.4%).

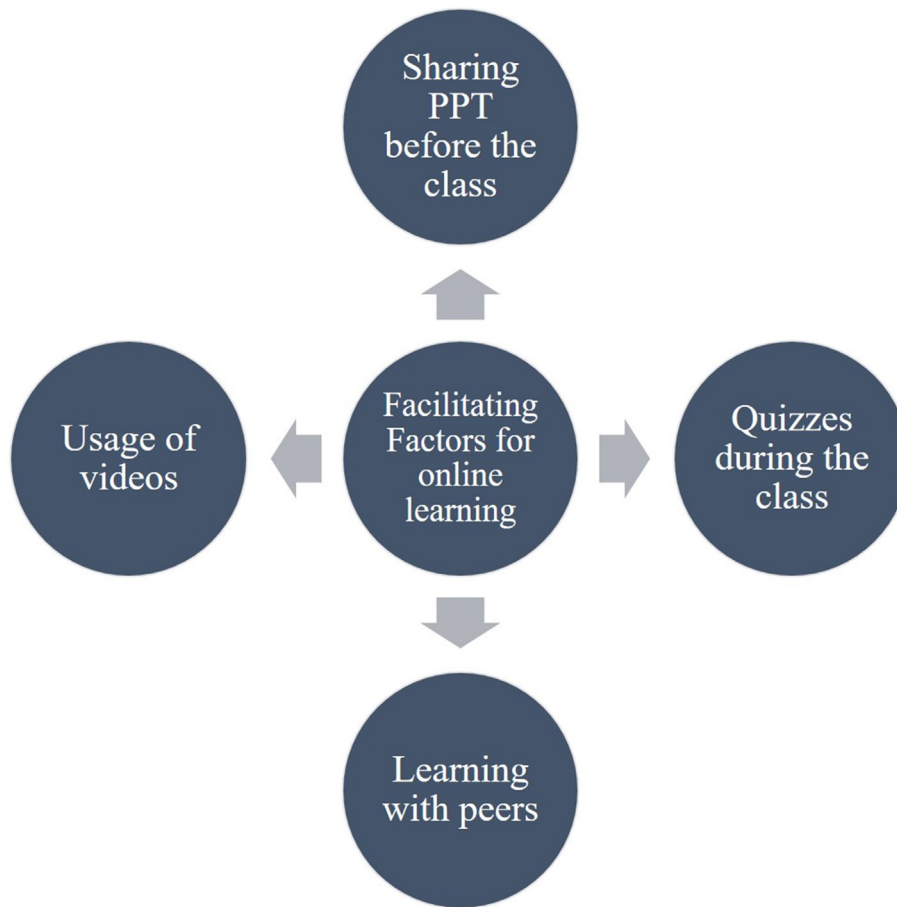### 5. *Facilitating and hindering factors*

The students found faculty sharing the class PowerPoint before the lecture as one of the most facilitating factors using a 1−4 ranking scale (mean rank 3.11 ± 1.02), followed by interaction with the faculty during an online lecture (2.64 ± 1.05), accessibility to the recorded lectures (2.52 ± 0.9) and online assignments, and FAs (1.73 ± 0.98). A one-way ANOVA test revealed a statistically significant difference between these groups (p < 0.0001).

When asked to rank the hindering factors using a 1−4 ranking scale, students ranked internet and technical glitches first, with a mean score of 3.28 ± 1.02. Limited access to interaction with the teachers (2.43 ± 0.96), easy access to distractions such as social media (2.3 ± 1.10), and limited peer interaction (1.99 ± 0.95) were ranked successively. The one-way ANOVA test revealed a statistically significant difference between these variables (p < 0.0001).

When asked about student preparedness for continuing online classes, we obtained a mean rank of 5.59 ± 2.87 (Promotors-29, passives-42, and detractors-99) (range 0−10).
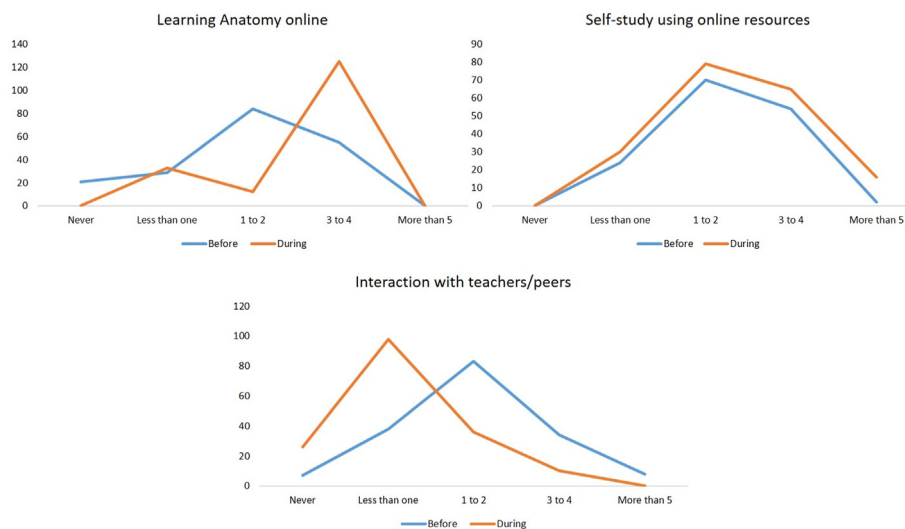
Figure 1: Graph showing major differences in the number of online learning and interaction hours before and during lockdown.

Figure 2: Schematic representation of facilitating factors for online learning.

Qualitative analysis

Of the 169 students who answered the questionnaire, 81 provided their views for the open-ended questions on facilitating factors, hindering factors for learning, how they have equipped themselves to overcome them, and how students have equipped themselves to understand better (Annexure 2).

The themes identified as major facilitating factors, hindering factors, and measures taken to overcome the hindering factors are represented in Figures 2 and 3.

Further, students stated that learning Anatomy without cadaveric demonstrations would lead to limited understanding of the concepts. In addition, the lack of visualizing histology slides made it challenging to understand microanatomy.

"The feel of learning in a classroom is obviously not met and dissection is the only way anatomy is understood. Histology is also better understood only when we see the slides ourselves, observe, and find the structures" (Male student).

"It's very difficult to do all this without the dissection. However, YouTube helps a bit. But still something is missing" (Female student).

Based on student feedback, we undertook the following remedial measures. These measures are still in practice even for the current academic batch in the prevailing pandemic.

Modifications made in online teaching/learning anatomy

1. **Increased interactions during online lecture sessions**

The online lecture sessions were made more interactive by incorporating formative quizzes, polls, short assignments, and group discussions. We made sure to complete each lecture with an instant FA online quiz, and provided immediate feedback at the end of the session. The students were also encouraged to use the 'chat box' to post queries, which teachers diligently answered. The 'chat-box' was also used to answer questions posed by teachers virtually, similar to traditional face-to-face teaching.

2. **Introduction of video demonstrations**

Video demonstrations of the dissected cadaveric specimens, surface marking, embryology models, and osteology were introduced as a part of practical learning. The faculty recorded the demonstrations with the help of the institutional audio-visual team. The videos were then streamed asynchronously a day before the scheduled online practical session. The videos were uploaded on the Microsoft Stream platform, where students could view them.

During the synchronous practical online session, students were clustered into groups of 20–25 (similar to small group teaching), and were facilitated by a faculty. The faculty
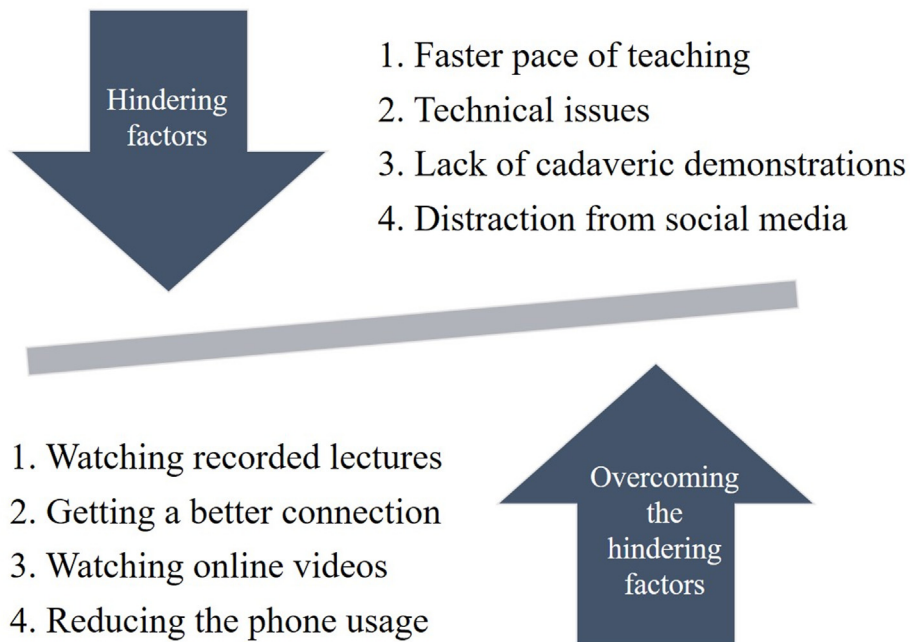
Figure 3: Illustration demonstrating the hindering factors and the methods by which students tried to overcome them.
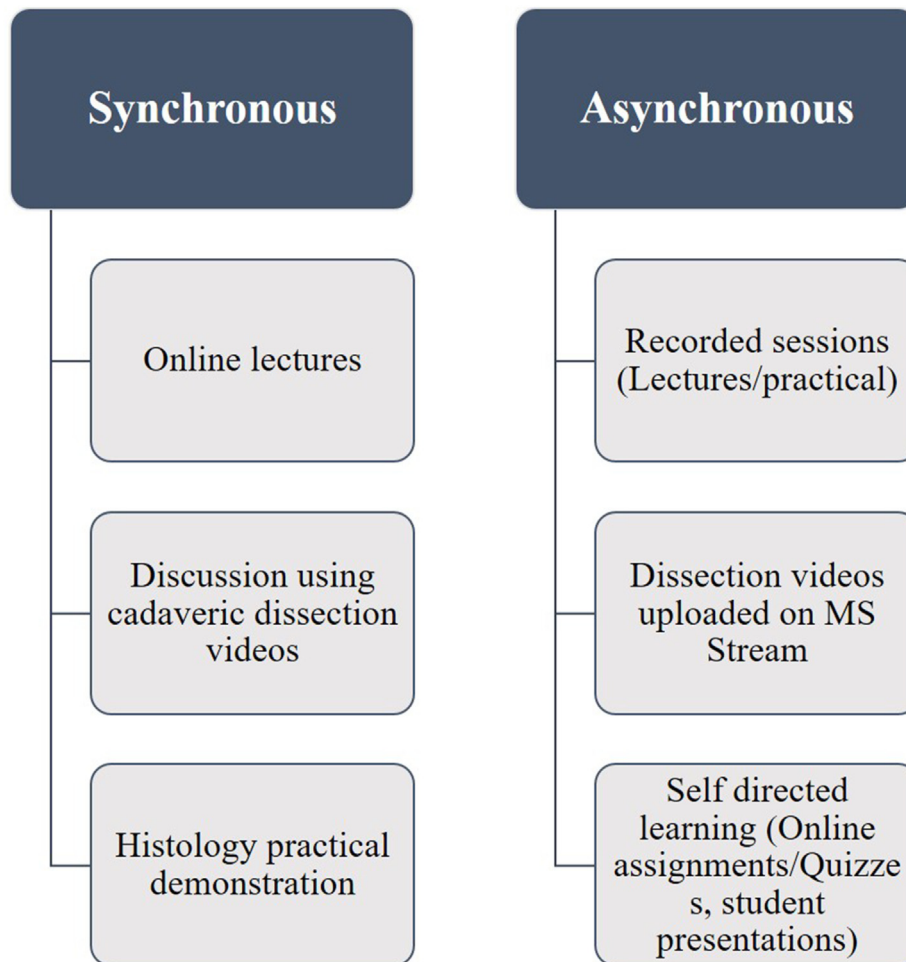
Figure 4: Illustration depicting the compiled list of synchronous and asynchronous teaching modalities followed during the pandemic.

would re-run a particular video, and discuss the fundamental concepts as and when required.

Conduct of online histology practical classes

Conducting the online histology practical was yet another challenging task. The practical needs of learning histology online were met using image-based discussions. The microscopic images of the histology slides used in routine practice were photographed. These images were used during the online sessions, where key features were discussed. The sessions were also made interactive by incorporating quizzes or short tests.

3. **Self-directed learning**

We introduced self-directed learning sessions in the form of individual and group assignments, and student presentations. After an online theory class, we chose a topic of interest, created the assignments, and notified students through the LMS. The students were given a choice to complete the assignment individually, or in groups of 3–5 students. The completed assignments were then uploaded by the students on the LMS, and were evaluated by the faculty.

We also introduced student presentations for the Genetics topics. The topics were given to the student groups (20–25 in each group) well in advance. The students worked as a team and made the presentations in PowerPoint, which were validated by the faculty. On the day of the presentations, a student representative from each group presented the topics, followed by active discussion. The sessions were facilitated by faculty, who provided constant feedback.

A compilation of all synchronous and asynchronous teaching modalities followed during the pandemic is presented in Figure 4.

Discussion

The COVID-19 pandemic has prompted the teaching fraternity, including Anatomists, to shift to online teaching. It required teaching faculty to gain competence in the delivery of online education almost overnight.[9–12]

The present study describes our teaching experiences during the transformation from traditional face-to-face to online learning during the pandemic. Students' perceptions about online Anatomy learning, the challenges faced, and the efforts made to overcome them are also discussed.

Utilisation of an online learning platform

Previous studies have portrayed the current generation of learners (Generation Z) as digitally sound and literate.[13] Studies have also indicated the readiness of the current generation of students to engage with technology-based solutions.[14,15]

Although participating students were technologically advanced, the majority of them (180 detractors) did not prefer learning Anatomy entirely online. The key reason was the inability to attain a three-dimensional orientation of the structures essential to learn Anatomy. Similar observations were made by other authors.[17,18]

Reproducing conventional anatomical teaching is challenging using the online mode. An online setting cannot readily convey the three-dimensional concepts and tactile properties of structures.[16] At the same time, digital resources may permit a detailed, high-quality prosection, and potentially, a virtual dissection. Digital modelling may also enhance the teaching of complex anatomical concepts.[16,19] Therefore, combining conventional approaches with digital resources may optimize learning.[16] In the present study, the students participated in video-based cadaveric dissections online, and strongly opined such an approach would give them a better orientation to learn Anatomy.

Interaction and learner engagement

The number of hours utilized in self-learning Anatomy showed a difference, with few students spending long hours learning during the pandemic. The onset of online courses made students seek the support of e-books and other educational resources available online to meet their learning needs, which considerably increased their screen time.

Interactions with teachers and peers also considerably reduced during this period. The mode of learning being online, students were not comfortable in interacting with their teachers and peers as much as they would in a traditional face-to-face setting. Similar observations were also reported by Yoo et al.[20]

Feedback on teaching pattern during the pandemic

The study observed that most students did not favour the arrangement of teaching only the theoretical concepts of Anatomy, without immediate practical exposure.

When students lost access to the practical sessions in Anatomy, they lost access to cadavers and a range of other learning tools such as prosections, embryological models, histology slides and microscopes, bones, and skeletons, etc.[21] While earlier studies have highlighted how the modern medical curriculum has reduced the duration of students' exposure to anatomy learning,[22] the prevailing pandemic has led to a further reduction. As a result, students are currently being taught anatomy without access to practical-based learning materials. Although learning Anatomy without cadavers is generally less favourable, it has arguable merits and has been used as a standard in many institutions.[23] However, when prosections, models, and other learning materials are also removed, learning becomes extremely difficult. Simply providing an online atlas may fail to provide students with an 'appreciation for the fabric of the human body'.[24] Despite various anatomy software available for students to use, they may not be effective in clarifying concepts and exploring the complex structures in the human body, unless guided by faculty.[18,25] The involvement of faculty as facilitators becomes necessary in these instances; faculty should guide students with the use of e-learning resources for effective learning.[26]

Video-based demonstrations of the cadaveric structures may fulfil the practical requirements, as reported by Barry et al.[27] In the present study, students felt that the video demonstration was the best possible way to impart practical Anatomy during the lockdown. Similar views

have been put forth by other authors who stressed that although various 3D Anatomy software packages are available online, they are expensive.[28] The preparation and streaming of institutions' own-recorded practical sessions would be highly beneficial and effective in educating students during online sessions. The recorded sessions could be safely stored in the appropriate repositories, and utilized as needed.[29]

The educational resources developed for online teaching are a one-time investment, and can be used continually for all subsequent batches. They will serve as an excellent supplement to traditional teaching, including dissection, even after a return to offline teaching post-pandemic.

Preferred learning strategies

The findings of the present study indicate that students opted equally for both asynchronous and synchronous learning. Studies in the past have revealed that asynchronous online teaching-learning is effective in improving student learning outcomes in anatomy teaching.[30,31] However, the benefits of synchronous teaching-learning during the prevailing pandemic cannot be unequivocally denied.[32] Therefore, we followed a blend of both synchronous and asynchronous teaching-learning.

In the present study, students found FA quizzes extremely useful for learning, followed by online group activities. These attempts increased student involvement in the online sessions. Students further agreed that FA quizzes made available online (asynchronous) helped them learn better, and aided in continued learning.

A previous study had similarly stated that the inclusion of formative quizzes during online teaching sessions allowed students to gauge their understanding of the learning objectives, and aided in their learning.[33]

In fact, the benefits of using formative quizzes during revision and teaching sessions have been highlighted by many studies.[34–36] Therefore, it is rightfully justified to introduce them during online Anatomy sessions. These attempts can provide instant feedback to both students and faculty, and thereby further enhance teaching-learning.[33]

Facilitating and hindering factors

Supplementing online teaching with reading materials in the form of PPTs and YouTube links have consistently reinforced learning, as mentioned in the studies conducted by other institutes.[20,37] Even in the present study, faculty sharing class resources during online teaching was most helpful, and facilitated learning, as indicated by the students.

Poor internet connectivity and technical glitches were considered as significant hindering factors to learning anatomy online. Students in medical schools elsewhere were also not in favour of online platforms, and the reasons cited were network issues.[37,38]

Limited access to interaction with teachers, easy access to distractions such as social media, and little peer interaction, were the other hindering factors identified.

Reduced interaction and discussion between teacher and students can deprive online sessions of their benefits, vibrancy, and vitality in a way that can make it feel as if the class has lost its charm. The 'instructor-content-student interconnectedness' should therefore be worked upon to improve the efficacy of Anatomy teaching-learning.[9]

Limitations of the study

In the present study, the authors did not observe differences in responses between male and female students. Additionally, we did not correlate student responses with their learning outcomes by following up the student cohort over a period of time. There is scope for further research in terms of determining the effectiveness of new learning strategies with student satisfaction and their academic performance.

Conclusions

During these tough pandemic times, when there is no hands-on access to learning resources such as cadavers, microscopes, embryological models, etc., the technology-enhanced online mode plays a significant role in learning. There should be a balance between synchronous and asynchronous teaching methods to provide a better learning pace. The incorporation of more self-directed learning strategies would help students to stay motivated to learn. Timely student feedback needs to be considered to modify teaching-learning methods for optimal outcome. The study concludes by stating that an online teaching schedule should be tailored to suit student learning needs. These efforts would promote better student engagement and effective teaching-learning during these difficult times, as detailed in the present study.

Recommendations

The technology-enhanced online mode of Anatomy learning will be the new normal. Therefore, a balance should be maintained between synchronous and asynchronous teaching methods to provide a better learning pace. Online teaching in Anatomy should be designed by considering the students' learning needs. Further, determining the effectiveness of the newer teaching-learning strategies by correlating it with student satisfaction and their academic performance would be beneficial.

Source of funding

Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

The Institutional Ethics Committee, Kasturba Medical College Manipal, granted ethical clearance (IEC338/2020) dated 23-06-2020. The questionnaire was administered to the

students after obtaining their informed consent (as mentioned in the first page of the questionnaire). The students agreeing to fill the questionnaire was considered as their voluntary participation in the study.

Authors contributions

SP and ADS conceptualized the project and planned the methods, collected the data, and prepared the original draft. AkKP assisted in the conceptualization and planned the methods. He also helped with the data analysis and critically reviewed the draft manuscript. ArKP contributed by planning the methods, and critically reviewing the draft manuscript. PLC supervised the project and provided resources for its execution. He also contributed to the preparation of the draft manuscript. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

Acknowledgment

Conference presentation

Abstract of part of this research paper has been accepted for e-poster on-demand category in AMEE 2021- A Virtual Conference that will be held during 27th to 30th August 2021. Dr. Sushma Prabhath presented the poster and she has received free registration award to attend the conference.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jtumed.2021.10.014.

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