ORIGINAL ARTICLE

Online Neurobiology Course - An Emergent Plan during the Pandemic

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ABSTRACT

OBJECTIVE: To obtain student's perceptions of the online neurobiology course conducted during the pandemic.

METHODOLOGY: A cross-sectional survey was conducted among the MD3 (year 4) students. One hundred thirty-three students enrolled in the neurobiology course submitted their responses to the survey. The survey was administered as a questionnaire on a five-point Likert scale to record the student's perception of the different aspects of the course. Descriptive and Chi-square analyses were employed among the variables. Data was statistically analyzed using IBM SPSS version 22. Descriptive analysis was used to analyze students' perceptions of how the online course was administered. The Shapiro-Wilk normality test results for all survey items ($p=0.000$) indicate that participant responses were not normally distributed. Chi-square (Inferential statistical procedures) were employed to test hypotheses exploring associations among variables.

RESULTS: The feedback analysis reflected that the students reacted positively to the modified teaching interventions and assessments. Most of the students were satisfied with the mode of delivery of the course and rated the course highly.

CONCLUSION: The survey results indicated that the online neurobiology course successfully addressed the course learning outcomes. Lessons from these experiences and taking advantage of educational technologies can help design technology-aided blended learning courses to enhance teaching in the upcoming academic years.

KEYWORDS: Neurobiology, pandemic, online, course, assessments, neuroanatomy

INTRODUCTION

Neuroanatomy includes the study of the nervous system's structure, whereas neurophysiology deals with the functional aspects of the nervous system. In most medical colleges, neuroanatomy is covered during the anatomy classes in the first year of study, whereas neurophysiology is addressed during the physiology classes. In some institutes, including the present study, neuroanatomy and neurophysiology are covered as a separate course termed neurobiology[1].

The study of the nervous system is generally perceived to be complicated by most of the students, which led to the term neurophobia being coined by Jozefowicz[2]; this could be due to insufficient teaching methods or difficulty in understanding the basic concepts[3].

Various teaching-learning methods like problem-based learning (PBL), case-based teaching (CBT), and team-based learning (TBL) have been implemented and were shown to decrease neurophobia by enhancing learning[4].

Arantes et al. reported the different methods used to teach neuroanatomy after reviewing 214 studies. They said online and offline modes were equally used for teaching neuroanatomy[1]. And recommended several methods to improve student outcomes, including emphasis on questions based on recall, use of case-based studies, class of shortened lectures, inclusion of conceptual exercises, use of flipped classroom approach, use of self-instruction laboratory stations on neuroanatomy, and adding three-dimensional models[1].

The COVID pandemic halted the regular mode of education in almost all universities in the world. The educational activities had to be continued in an online mode[5]. This abrupt shift to the online teaching mode required institutions to create a curriculum design focused on effective pedagogy and one that considers student participation and engagement [6].

The critical situation posed by the pandemic greatly impacted course delivery in the institution of the present study. The neurobiology course had to be abruptly shifted to an online mode as all face-to-face teaching was suspended a few days before the commencement of the course.

With limited literature and resources available, the faculty had to develop innovative plans so that student's learning process was not affected. The neurobiology course was always perceived as challenging by the students, and now, being shifted to an online mode has made it all the more challenging.

At the end of the course, feedback was obtained to study the students' perceptions of the various teaching and assessment strategies employed during the online neurobiology course.

METHODOLOGY

A descriptive cross-sectional study based on a survey questionnaire was conducted on the fourth-year (MD3) medical students enrolled for the neurobiology 2020 course. Approval from the institution's Institutional Research and Ethics Committee was obtained to conduct the study, which was carried out in line with the Helsinki protocol. Convenience sampling was employed, and all the students (133) who took the course were included in the study.

Study setting: The institution in the present study offers an MD program a 7-year undergraduate medical degree. The fourth year (MD3) is the first preclinical year, during which the student takes courses in human structure, human function (including physiology and biochemistry) and neurobiology.

The Neurobiology course is an 8-week course taken during May to July. It is an integrated course facilitated jointly by the faculty of anatomy and physiology and includes neuroanatomy and neurophysiology topics.

Before the pandemic, the neurobiology course was taught in an integrated fashion with a constructivist approach7. The teaching of the functional aspects followed the explanation of the nervous system's structure. Small group discussions in the form of student presentations and team-based learning (TBL), which are graded and included in the in-course assessments, were also implemented.

The midterm and final exams have both the theory and practical components. The theory part is conducted online in the exam hall on the college learning management system SOLE (Secure Online Learning Environment). The practical aspect is an objective structured practical examination (OSPE).

During the pandemic, the lectures for the online course were delivered as live online classes on the digital platform WebEx. During the online lectures, student engagement was enhanced using the 'polling option' available in WebEx, which aided in maintaining student attention and interest. The recorded sessions of the lecture classes were posted in SOLE for the benefit of the students who missed live classes. During the online course, only 2 hours were utilized for lectures each day, and 2-4 hours were conducted for digital lab sessions per week; this was done to reduce the stress on the students who, along with the challenges created by the pandemic, had to take an online course for the first time. An hour every day was assigned for a 'question and answer session' so that students had an opportunity to clear their doubts about the topics taken. The instructors also used this hour for formative assessments through the online polling option available in WebEx. During the online digital practical sessions, the lab objectives were covered using the presentation with annotations. Recordings of the sessions were later uploaded on SOLE.

The assessments were administered as assignments and were released on SOLE. The assignments were based on course objectives and aligned with Bloom's Taxonomy[8]. Higher-order thinking questions were included to promote critical thinking. Combinations of multiple-choice questions, short answer questions, fill-in-the-blanks and match the following were used. One of the assignments was administered as a group project. For the project, the students were encouraged to form groups (4-5 students in each group) at their convenience. Each group was given topics with specific objectives related to clinical applications of neurobiology, and the instructions and rubrics were also provided accordingly.

Study instrument: The course was later evaluated using a survey questionnaire filled out by the students after informed consent was given. The survey's objective was to analyze the efficacy of

the teaching and assessment strategies employed during the sudden shift to online teaching mode during the neurobiology course.

The questions for the feedback (**Table I**) were prepared based on prior annual student surveys[9,] and the faculty members administering the course were consulted to establish face validity. The evaluation was performed on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree).

Table I: Questions asked in a feedback questionnaire

Question No	Question asked
Q1	The Neuroanatomy online classes were well taken, and all the objectives were covered.
Q2	The Neurophysiology online classes were well taken, and all the objectives were covered.
Q3	The online digital labs were well taken and helped me understand the anatomy of the nervous system in neurobiology.
Q4	Q&A sessions helped solve queries on the topic.
Q5	The Assignments were well prepared.

In addition, open-ended questions were asked where the students were asked to comment on the online classes and digital labs. Space was also provided for students to give suggestions for improving the course in the future and also express if they faced any difficulties.

A Cronbach's alpha value of 0.845 was obtained for quantitative items of the feedback questionnaire, indicating good internal consistency.

College learning management system SOLE was used to release the survey, which was anonymous, with informed consent, and not linked to any student evaluations. The data collected was tabulated and statistically analyzed.

Statistical analysis: Data was statistically analyzed using IBM SPSS version 22. Descriptive analysis was used to analyze students' perceptions of how the online course was administered. The Shapiro-Wilk normality test results for all survey items ($p=0.000$) indicate that participant responses were not normally distributed. Chi-square (Inferential statistical procedures) were employed to test hypotheses exploring associations among variables.

RESULTS

All the 133 students registered for the neurobiology course completed the course and filled in the feedback questionnaire.
The responses to the close-ended questions (total of 5 questions asked) administered on a 5-point Likert scale are depicted in **Graph I**.

Graph I: Responses to questions on the Likert scale
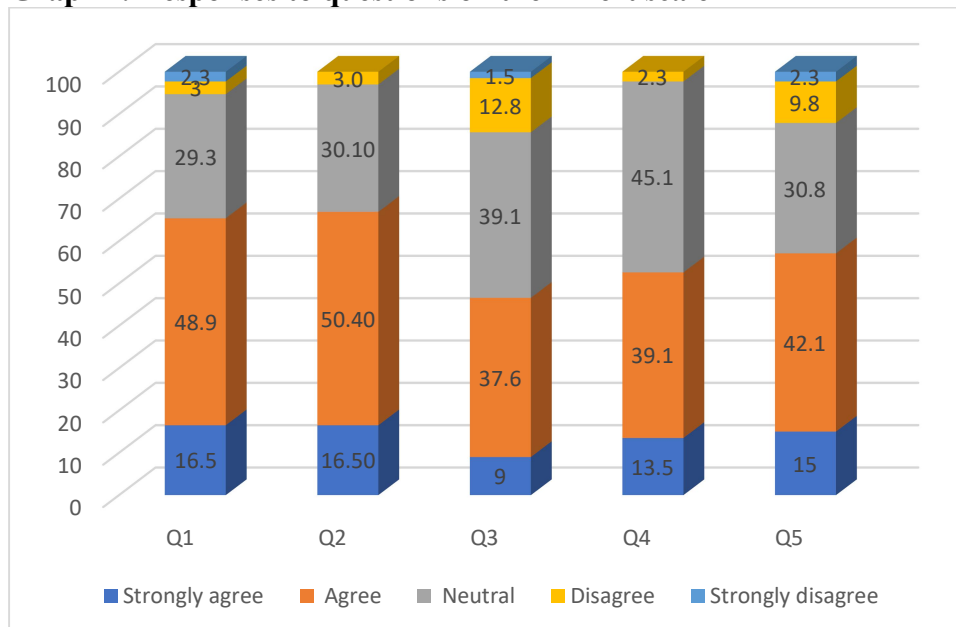
When asked if the neuroanatomy classes were well taken with objectives covered, 65.41% of students agreed or strongly agreed, 29.32% were neutral, and only 5.27% disagreed.
66.92% of students agreed or strongly agreed that the neurophysiology classes were well taken with the objectives covered, 30.8% were neutral in their response, and 3.01% disagreed about the neurophysiology classes.
When asked if the online digital labs were well taken and helped understand the anatomy of the nervous system, about 46.61% of students agreed or strongly agreed to it, 39.1% were neutral in their response, and approximately 14.28% disagreed or strongly disagreed.
45.11% of students were neutral when asked if the question-and-answer sessions helped solve the queries. 52.63% agreed or strongly agreed, and 2.26% disagreed that the session helped solve the queries.
When asked about the assessment administered as assignments were well prepared and administered, 57.15% of students agreed or strongly agreed to it, 30.83% were neutral, and 12.03% disagreed or strongly disagreed.
When asked to rate the neurobiology course on a scale from 1 to 10, most of the students rated the course above 5.
Responses to open-ended questions: In response to the open-ended question that asked if the lectures in the course were well taken and covered the objectives, most of the students were satisfied with the efforts taken by the faculty to conduct the online lectures, which included student engagement.

Few students expressed problems with internet connectivity during the online classes. In contrast, a few students said that the lecture was sometimes lengthy and that clearing doubts could have been done at the end of the session so as not to interrupt the flow of classes.

For the digital labs, most students said they missed being in the dissection hall and studying with the corpses. Though the digital lab sessions were well taken, they preferred to be in college to handle the specimens.

When asked to share suggestions to improve online courses and any difficulty faced during the course, most students again echoed the difficulty with internet connectivity during the online classes. They were eagerly waiting to return to the college campus.

Chi-square analysis showed significant inter-item association (**Table II**). A good association between the various feedback domains positively indicated a comprehensive student experience during the course.

Table II: Association between the questions as observed with the Chi-square test

Association between questions	Chi-square value	P Value
Q1 & Q2	226.519	.000
Q1 & Q3	66.148	.000
Q1 & Q4	31.797	.001
Q1 & Q5	79.480	.000
Q2 & Q3	61.214	.000
Q2 & Q4	42.408	.000
Q2 & Q5	69.850	.000
Q3 & Q4	42.295	.000
Q3 & Q5	35.239	.004
Q4 & Q5	41.784	.000

DISCUSSION

Disruption in medical education due to the COVID pandemic was a global phenomenon.
Most countries were either at the end or beginning of the academic year of medical education when the pandemic erupted[10].
Most educators faced the challenge of suddenly shifting to an online teaching mode. With the deficiency of time and scanty literature available to deal with such situations, anatomy teachers had to find the best method to administer teaching to continue or start the academic year.
Course delivery in the present study was also not immune to this emergence and required a shift of the neurobiology course to a completely online mode. Face-to-face lectures were entirely converted to an online mode and were made interactive using student engagement tools. Most students reported that they were satisfied with how the lectures were conducted.
Pather et al. documented the shared experiences of 18 anatomists from 10 institutions in New Zealand and Australian universities about the teaching administered during the pandemic. They found that the lecture delivery was either live-streamed on campus or from home, or they had used previous lecture recordings as an asynchronous approach. Student interaction using applications like Kahoot quizzes was also a part of the interactive lecture by most the anatomists[10].
In another study, an anonymous cross-sectional survey was carried out to assess the quality of the course, attendance of students, and effectiveness of online teaching programs on undergraduate medical students, pediatric rotations residents, neonatal care fellows, and their respective teaching faculty. Most students (89%) agreed that online teaching conducted during the pandemic was suitable for administering the course.
The use of technology in gross anatomy and neuroanatomy teaching was undertaken before the pandemic and has proven to be an effective aid in improving learning[11].
Totlis et al. conducted a cross-sectional survey on undergraduate medical and dental students to understand the impact of COVID-19 on teaching. They compared the anatomy taught traditionally with the distance online teaching modalities. Though the students were not happy with the remote educational method, they rated online anatomy lectures and anatomy lectures that were prerecorded in second place regarding usefulness and liking compared to learning by self by listening to the recorded anatomy lectures[12].
Though not an ideal teaching method, online teaching was the only effective method educators could use during the pandemic. Most of the institution's lectures were administered live synchronously or asynchronously using prerecorded lectures[12-14].
The study of neuroanatomy or any gross anatomical structure is incomplete without studying wet brain or cadaveric specimens.
One of the challenges in the present study was the lab session scheduling; since students could not attend the offline labs, it had to be substituted with online digital labs.
Due to a lack of definitive protocol, the dissection hall could not be used to record the lab demonstrations. Being exposed suddenly to an online mode of teaching, 3D software to aid online learning could not be accessed.
Diaz et al. used a series of twenty videos recorded before the anatomy laboratory session using cadaveric tissues to cover the practical aspects of teaching. Further Zoom tutorials allowed students to discuss and ask questions regarding material [14].
Flynn et al. administered the practical teaching in their institution using a wired communication platform, blackboard collaboration, and the Visible Body application, a three-dimensional anatomical program[15].

Similar methods were also used in other medical schools where face-to-face practical teaching was replaced by an online suitable class or by sharing recorded videos prepared before the pandemic[10,14].

No learning process is complete without assessments, be it formative or summative.

In the institution reported in the present study, the assessments are regularly conducted online. Still, the most significant disadvantage during the pandemic was problems with internet connectivity and the unavailability of proctoring software to mitigate the usage of unfair means.

While planning for assessments, the authors in the present study were similar to the one expressed by most of the anatomists who were confronted with the problem of student collusion while answering the tests. Questions that involved understanding and analysis of the subject rather than just recall were administered, as these type of questions helps the students to think critically before locating the answer, and if the students collaborate during an exam, then at least they engage together in reaching a solution[10].

The practical aspect was also assessed online using image-based questions in a limited time frame in most institutions, including the present study[10,14,15].

An innovative assessment method was carried out by Gupta et al., where the assessment was carried out in an interview mode, which was administered either as a telephonic interview or WhatsApp video call and Zoom meetings based on the choice of preference of the students[16].

There were instances where few universities cancelled their assessments; this was reported in a study by Longhurst et al., who gathered data from the anatomy educators of 14 universities from the United Kingdom and Ireland. According to their report, 14% of universities did not conduct summative assessments, 36% called off their assessments, and 21% conducted digital spotter exams online. Written exams were cancelled in 7% of universities, 36% opted for exams using different question formats, and 21% carried an open book exam[17].

Elshami et al. recorded the perceptions of students and faculty regarding online learning. The students' satisfaction percentage was 41.3%, whereas it was 74.3% for the faculty. Students were mainly satisfied with the available communication and the flexibility in the administration of the course. In contrast, most of the faculty were happy with the students' eagerness to participate in the online learning. They suggested a blended teaching mode that included synchronous and nonsynchronous approaches, using different software for student engagement, and taking timely feedback, which is essential to increase student satisfaction[18].

In another study, a questionnaire was administered to 2,263 medical students to record their views regarding the strengths and weaknesses of online teaching vs. traditional teaching, and most of the students (78.12 %) agreed that they missed anatomy teaching administered traditionally. Most students (92.92 %) missed being on campus and participating in the college social life. The students strongly felt the gap in understanding the practical aspects of anatomy which is generally administered in the dissection halls and through microscopic slides for histology; a lack in the visual orientation of the subject was felt. The lack of proper devices for online learning and the absence of broadband internet were also issues that hurt online learning. Though all the academic institutions went through a rough period during the pandemic, most institutions adapted to the change and paved the way for innovative teaching[19].

The emergence of the COVID pandemic acted as a change agent; it helped the faculty explore various innovative online teaching methodologies. The faculty had to think outside the box, plan strategies that helped fulfil the teaching component of the course, and conduct a fair assessment.

CONCLUSION

Due to the pandemic, the neurobiology course in the present study was shifted to a completely online mode. Adapting to this sudden change in course delivery was a significant challenge. However, the efficacy of executing teaching-learning strategies to fulfil course objectives was well achieved, as seen by the results of the student feedback. Modifications in assessment methods were also well received by the students.

The experiences of online teaching can act as a trigger to implement an online component in the further teaching of the neurobiology course and pave the way for a blended learning environment to enhance the teaching and learning environment.

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AUTHOR'S CONTRIBUTION

Kore SE: Principal investigator, conceptualization, and writing
Simon MA: Statistical analysis, writing and review
Vishwakarma N: Data collection and writing
Siddiqui N: Data collection and review

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