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Indian Journal of Physiology and Pharmacology

Medical Education

Online physiology teaching for nursing students during the COVID-19 pandemic – strengths, challenges and reinforcement measures

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Received: 01 June 2023
Accepted: 28 September 2023
EPub Ahead of Print: 15 January 2024
Published: 30 March 2024

DOI
10.25259/IJPP_304_2023

Quick Response Code:

ABSTRACT

Objectives: The forced shift to online education during the COVID-19 pandemic posed several challenges to Indian nursing education, especially with a complex subject like physiology. The objective of the study was to assess the apprehensions, expectations, and challenges perceived by nursing students and physiology faculty about the online mode of learning physiology, to evaluate the utility of reinforcement measures during the constraints of the pandemic, and to compare the online, offline, and blended modes.

Materials and Methods: First-year nursing students (n = 100) underwent online and blended modes of physiology learning, with added reinforcement measures, during the pandemic. Beginning, mid, and end of course feedback was taken from students on the expectations and perceptions of the online mode. Feedback was obtained from students and faculty to understand the strengths and challenges of both modes. Quantitative data of student feedback were analysed using the Cochran-Mantel-Haenszel test. Thematic content analysis was used for qualitative data. Objective measures of student performance were compared using unpaired t-tests.

Results: Online learning was perceived to be more difficult than anticipated by students. 'Comfort' in learning and 'time management' were the major strengths, while 'reduced internet connectivity,' 'lack of interactions' and 'health issues' were the biggest challenges expressed by students and faculty. The planned reinforcement measures were 'sometimes' helpful in revising and improving students' confidence. The final summative assessment scores of students showed a better performance compared to the preceding academic batch.

Conclusion: Students and faculty expressed some advantages and several disadvantages of online learning. They preferred offline or well-designed blended learning. The reinforcement measures seemed to aid student learning. The objective measures of assessment showed that students adapted well to the online mode. A model for blended learning for 1st-year nursing education, that utilises the advantages of both modes of learning, has been proposed, which requires further validation.

Keywords: Online physiology teaching, Blended learning, Reinforcement measures, Pandemic situation

INTRODUCTION

Online teaching-learning methods in higher education are gaining increasing importance;[1,2] however, their importance in nursing education is debated. Nursing students train to become healthcare professionals whose work involves being 'present' in the real world, in real time, and interacting with people face to face. It is argued that online teaching devolves the responsibility among health care professionals to be 'present.'[3] The online mode of teaching has its own

challenges in terms of infrastructure and resources, especially in a middle-income country like India.[4] While the use of online methods, for medical and nursing education, was still in the nascent stage in India, the COVID-19 pandemic suddenly forced the education system to shift completely into the online mode.[5-7] The prolonged lockdown of educational institutions during the pandemic had serious implications,[8] impacting theory and practical learning, both in medical[5,9] and nursing[10-13] education around the world. Some of the implications were the suspension of clinical exposures, electives, formal teaching in wards, and offline opportunities for conference presentations, all being serious detriments to medical student careers.[5,9-13] It is opined that nursing education after the pandemic will appear different from the pre-pandemic era and that it must be geared toward addressing emergencies like the pandemic.[14]

The subject of physiology plays a major role in laying the foundation for medical science and has long been recognised as a difficult course. This is due to the inherent nature of the discipline itself and is not related to teaching or student learning. Learning the subject involves understanding dynamic processes, imbibing conceptual framework, and thinking in terms of purpose, cause, and effect.[15] Considering the nature of the subject, face-to-face, inquiry-based teaching brings in greater student engagement and better interaction. It is, therefore, considered more effective than an online mode of learning.[3,16]

In India, physiology is taught during the 1st year of the Bachelor course of Nursing (BSc Nursing), as prescribed by the Indian Nursing Council. First-year nursing students are usually naive to basic medical science subjects and to the online mode of learning. Even with the advantages of online learning, such as learning at the student's own pace and learning in the comforts of home,[17] it is indeed challenging to understand a complex subject like physiology in this mode, especially for students in the 1st year of the nursing course, with little background of human biology.[3,15,17] Nevertheless, due to the lockdown that the pandemic posed, nursing students in India experienced physiology teaching in the online mode.

With the sudden shift to online mode of teaching many studies were conducted to capture students' perception of online learning in medical[13,18-22] and nursing[23-25] education. These studies reported several strengths and challenges of the online mode. However, they were cross-sectional studies with 1-time feedback. While the advantages of the blended mode had already been reported before the pandemic,[3] the blended mode was preferred over the online mode during the pandemic as well due to its greater flexibility,[19] with Indian medical students perceiving it as the future of medical education.[25]

Educators have explored several online platforms, tools, and learning resources to make the best out of online teaching during the pandemic.[3,18,19,23,26] In studies before the pandemic, additional online reading materials and multiple-choice question (MCQ) quizzes have proven to improve student mastery of learning outcomes in physiology and were ranked high in the list of learning activities that contributed most to student learning experience.[3,24,25] Hence, periodic reinforcements such as extra reading material, practice questions and answers, MCQ tests, and revision classes, could help students cope with the new mode of learning during the pandemic. However, there are few studies that have explored these options during the pandemic.[19]

In the study setting, during the pre-pandemic years, classes and examinations for all subjects, including physiology, were offline. Both students and teachers had no experience with online/blended classes until the pandemic struck. The COVID-19 pandemic necessitated a complete lockdown due to which educational institutions and hostels were shut down and students had online physiology classes, attending from their residences. The pandemic was expected to recede and offline classes were expected to begin sometime during the academic year.

A prospective study during the COVID-19 pandemic capturing the perceptions and concerns about online and blended modes of learning from students and faculty, at multiple time points through the course, was worthwhile. This is especially true in the given setting where both students and faculty were naïve to online teaching-learning. Student perceptions at the beginning and middle of the course could prove to be useful feedback in altering the online teaching-learning methods, to address their concerns. The implementation of and feedback on reinforcement measures such as extra reading material and MCQ quizzes was also worth exploring.

This study was conducted with the primary objective of assessing the apprehensions, expectations, and challenges that nursing students anticipated initially and experienced at the middle and end of the course, with the online mode of learning physiology during the COVID-19 pandemic. Our secondary objectives were (a) to evaluate students' perceptions and learning outcomes of the online 'reinforcement' provided, in addition to the prescribed classes, to aid learning, (b) to evaluate the faculty perceptions of strengths and challenges of online physiology lectures for nursing students, (c) to evaluate faculty perceptions on strengths, challenges, and utility of the reinforcement measures administered online and (d) to compare student and faculty perceptions on the online, offline and blended modes of learning.

MATERIALS AND METHODS

The program was introduced in a private, not-for-profit, Catholic nursing college in Karnataka state of South India. As per the Institutional policy, only female students are admitted into the course of B.Sc Nursing. Students join the 1st year

of the course after completing 2 years of a pre-university course in science subjects (physics, chemistry, mathematics, and biology). Students qualify for admission through an Institutional level entrance examination and subsequent interview. Physiology, being a 1st-year subject, includes 60 h of classes and assessments (internal assessments and a final summative assessment), which students must pass by achieving a minimum score of 50%.

Amidst the COVID-19 lockdown, all 1st year B.Sc Nursing students admitted in the academic year from November 2020 to February 2022 attending physiology classes, aged between 18 and 30 years, were included in the study (n = 100, all females). The study was of a mixed-methods design and was approved by the Institutional Ethics Committee (IEC study ref no: 293/2020 dated 23.10.2020). Written informed consent was taken online on the Microsoft Team platform. Filling out the feedback questionnaires to capture their perceptions was made entirely voluntary.

Workplan

Course plan

The 1st year of the B.Sc Nursing course followed the physiology curriculum as prescribed by the State University (60 h: 50 theory + 10 practical demonstrations). Due to the pandemic lockdown, the course commenced and continued with theory classes in the online mode. Lectures were delivered by the faculty in an online meeting, on the Microsoft Teams platform, attended by the entire batch of students. Power-point presentations, which were in use for offline teaching, were continued online. Further, there was an increased use of extra videos, images, white whiteboard of PowerPoint, pointers, and stylus to make the classes more interactive and interesting. Faculty interacted with students by asking questions and pausing in between their didactic lectures, providing students opportunities to raise doubts, if any. After the completion of 43 h of online theory classes the lockdown was lifted. Educational institutions re-opened and students returned to the Institution for offline classes [Figure 1].

Resumption of offline classes

As the pandemic receded, 7 h of theory and 10 h of practical demonstration sessions were conducted in the offline mode. MCQ tests remained in the online mode and hence a blended method of teaching was adopted during this period. Reinforcement measures: Several reinforcement measures were introduced during online classes, having anticipated the challenges that students would face with the online mode of learning:

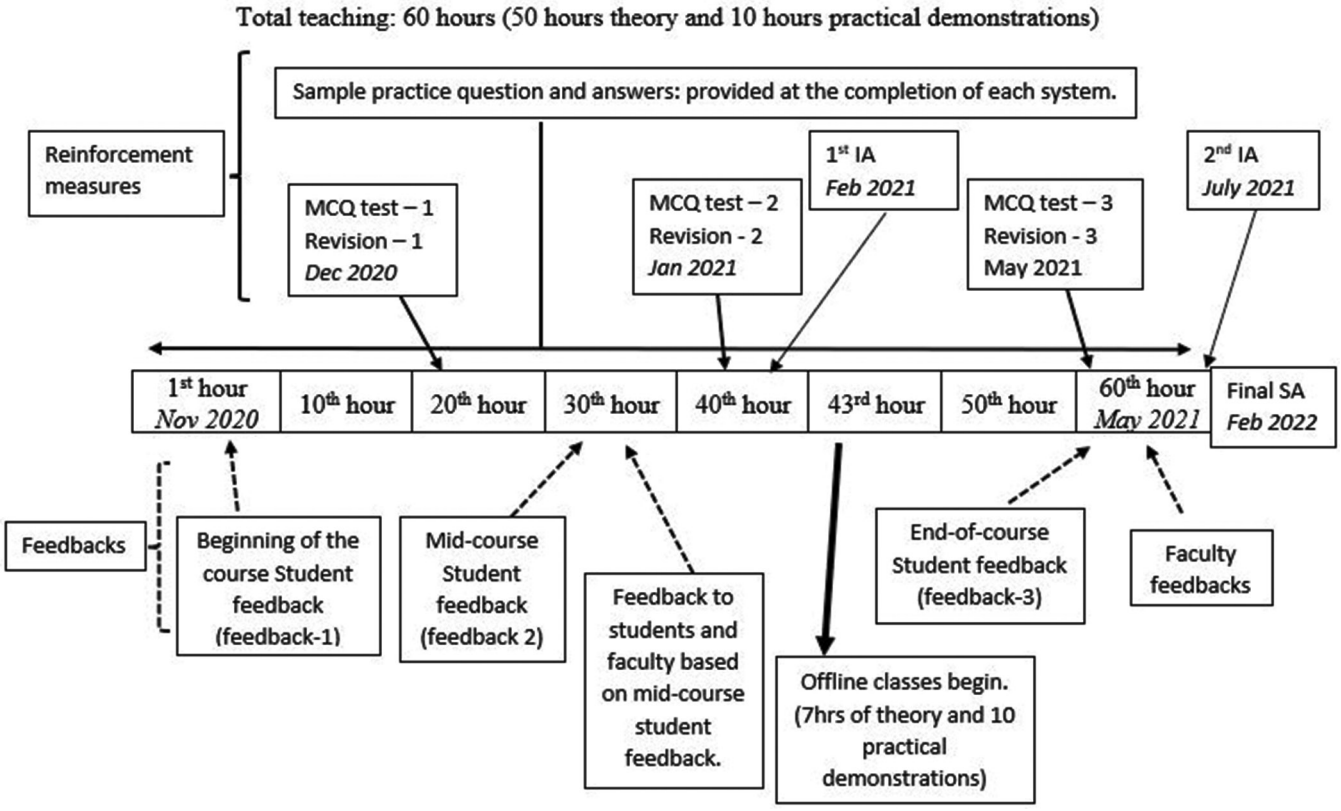

Figure 1: Workplan. IA: Internal assessment; MCQ: Multiple choice questions; SA: Summative assessment.

Practice questions

Each system was periodically uploaded on the Microsoft Teams platform. Questions that have appeared in earlier summative examinations were chosen as sample questions. These questions along with their answer keys (with references), with brief outlines of the physiological concepts, were provided, with the intent to encourage students to prepare themselves for assessments. Only a few sample questions (around 10 questions for each system) were provided; it was by no means a complete list and was meant for self-directed learning.

Periodic online MCQ tests

The MCQ tests were administered after content validation by expert peer review. With prior intimation to students, the 3 MCQ tests were held on the 20th (December 2021) 40th (January 2021), and 60th h (May 2021) of the course (out of 60 h allotted for physiology teaching). They included questions from the portion of the syllabus covered within those respective timeframes. Each test had around 30 MCQ 'must know' questions with equal weightage to the 3–4 systems that were provided as syllabus for each of these tests.

Periodic online revision classes

One revision class followed the MCQ test, conducted by the same faculty of physiology who conducted the online MCQ tests (at the 20th, 40th, and 60th h of the course). Revision included discussion of the MCQs and clarification of doubts related to the chapters covered in the respective MCQ tests.

Assessments

The first internal assessment was held online (February 2021), while the second internal assessment (July 2021) and the final summative examination (February 2022) were held offline for students of this academic year. The internal assessments and final summative assessment each out of a total of 38 marks and consisted of long essays, short essays, and short answers which were based on the format prescribed by the state university. The results of these were considered as objective methods of assessing student performance.

Regular student feedback

All feedback taken online, as Google Forms, was on the mode of teaching only and not on content/the faculty involved in physiology teaching/the institution. The feedback questionnaires were designed to elicit responses that address the objectives, which were framed based on the thematic framework for the study. The questionnaires were pre-validated, for content and construction, by expert peer review and tested for reliability by conducting a pilot with nursing students who were not part of this study but have experienced online teaching of physiology.

Students' feedback on online mode of physiology learning

Three feedback forms were administered on a voluntary basis. The first feedback was at the beginning of the course which intended to capture student apprehensions and expectations from the online mode of learning and challenges anticipated before classes commenced. The experience of the students with the online mode of learning, its strengths, and challenges were captured in the second feedback, at mid-course. The same for the offline and blended modes of learning were captured in the third feedback at the end of the course. In addition, the second and third feedbacks captured student perceptions on the utility of reinforcement measures. The questionnaires consisted of both closed-ended (yes/no and multiple-choice) and open-ended questions.

Measures taken based on students' mid-course feedback

Based on student feedback at mid-course, feedback was provided to the faculty on difficulties faced by students due to the online mode of learning. The faculty was requested to take measures, like uploading their PowerPoint presentations on the Teams platform and enhancing interactive teaching–learning. Students were addressed and advised with measures such as (a) buying textbooks, (b) working on their notes making, maintaining their concentration and positive attitude, (c) focusing on MCQ tests, (d) coming prepared for revision classes, (e) not hesitating to ask doubts and (f) using extra reading materials to their benefit.

Faculty feedback

At the end of physiology classes, faculty of the department of physiology who were involved in online physiology teaching and reinforcement measures were requested to fill out a questionnaire on a voluntary basis. The questions were intended to capture the strengths and challenges of the online mode of teaching physiology subject, in terms of ease of teaching, interaction with students, their confidence in using the online mode, time management, and the time and energy spent preparing the supporting academic resources for online teaching. The questionnaire also intended to capture faculty perceptions on the influence of the various modes of teaching on student learning. Faculty involved in the conduct of revision classes and MCQ tests (reinforcement measures) were requested to fill in an additional questionnaire that captured their perceptions on strengths, challenges, and utility of the reinforcement measures.

Data analysis

Data from the three student feedback and faculty feedback were collated and analysed periodically. The analysis was both qualitative and quantitative. The closed-ended questions with Yes/No responses have been presented as the actual number of responses and percentages. The responses to the MCQs administered at midcourse, on the experience of online mode of learning and at the course, on the experience of offline and blended modes of learning, were compared using the Cochran-Mantel-Haenszel test, and $P < 0.05$ was considered statistically significant (using Stata 16 software). The marks scored by the students in the 3 MCQ tests have been presented as mean ± standard deviation (SD). The performance in the final summative assessment (University exam) has been expressed as the mean ± SD of the scores obtained and the pass percentage of the academic batch. The performance of the study population has been compared with that of the students from the previous academic year (2019–2020) who had attended a completely offline mode of teaching using an unpaired *t*-test. Qualitative analysis of open-ended questions was done by each investigator independently using thematic content analysis. Codes, themes, and sub-themes were derived and a consensus of themes was arrived at by mutual discussion among the investigators. Themes have been substantiated with verbatim quotes or key phrases. The values in parentheses indicate the number of responses. Some overlap of responses was observed between responses to open-ended questions. Answering all questions was not made mandatory. Therefore, numerical values under descriptions do not add up to the total responses.

RESULTS

The students ($n = 100$, all females) had a mean age of 19.92 ± 1.37 years. The majority of them belonged to the state of Kerala ($n = 86$) and others to the states of Karnataka ($n = 8$), West Bengal ($n = 3$), Uttar Pradesh ($n = 1$), Jharkhand ($n = 1$) and Bihar ($n = 1$) where they resided during the lockdown and from where they attended the online mode of teaching. Ninety-nine students volunteered to provide feedback at the beginning of the course while 96 students responded at the middle and end of the course.

Student perceptions on modes of learning

Student response to closed-ended questions

Students' perceptions on several aspects of online and offline modes of learning were captured at the beginning (at the commencement of the online mode of learning), middle (when students were midway through the course and had experienced only the online mode of learning) and end of the course (when they had been exposed to both online and offline modes of learning).

At the commencement of the course, a few felt that 'ease' and 'interest in learning' would not be facilitated by the online mode. The number of students expressing this opinion increased significantly towards the end of the year ($P < 0.001$). Initially, students were divided in their opinion regarding 'interest in learning' and 'interaction with teachers' through the online mode. However, by the end of the year, a majority felt that the offline mode facilitated these aspects more than the online mode ($P < 0.001$). Students neither anticipated nor experienced difficulty in 'time management' with either mode. In the beginning, students were confident about 'support from academic resource material,' 'the use of technology' and their 'performance in the final exam.' However, by the end of the year, this confidence was reduced among a significant number of students ($P < 0.001$).

In summary, the experience of an entirely online mode of learning failed to meet student expectations expressed at the beginning of the academic year in all aspects except time management. By the end of the academic year, most students preferred completely offline teaching. Some preferred the blended (online + offline) mode [Table 1].

Student response to open-ended questions

Strengths and challenges of online mode of learning

Students expressed several strengths of the online mode of learning out of which the themes that emerged were 'comfort,' 'effective use of the teaching-learning methods,' 'effective time management' and some other added advantages. 'Technical issues,' 'lack of interaction,' 'learning difficulties' and 'health issues' were the themes that emerged out of the challenges expressed by the students.

"*Videos, diagrams of the particular units are being given, it makes the studies more comfortable…*"

"*I'm really fed up with online class. It really is strain to my eyes.*"

Student responses on strengths and challenges, from which the above themes emerged, are detailed in [Tables 2 and 3].

Strengths and challenges of the offline mode of learning

Several strengths of the offline mode were expressed such as 'better understanding of the subject,' 'more interest,' 'more interactions,' 'blackboard teaching being better than Powerpoint slides,' 'making notes being easier,' 'increased concentration' and 'subject being made easier' and 'more informative.' Challenges of the offline mode expressed were 'reduced speed of teaching,' 'issues in time management' and 'easy distraction with reduced attention span.' Few students felt that there was no difference from the online mode [Table 4].

Table 1: Student and faculty responses to closed ended questions on the online mode of physiology teaching.

Q	Stem and options of the questions	Q1 – feedback at the beginning of the course (*n*=99): No of students who expressed their feedback on the online mode of learning	Q2 – feedback at mid-course (*n*=96): No of students who expressed their feedback on the online mode of learning	Q3 – feedback at the end-of-course (*n*=96): No students who expressed their feedback on the offline mode of learning	Faculty feedback at the end-of-course on the online mode (*n*=9)	
1	Ease					
	Easy	16	7	58 (60%)*	5	
	Same	42 (42%)	25 (27%)	29 (31%)	1	
	Difficult	40 (40%)	63 (65%)	9	3	
	Impossible	1	1	0	0	
2	Interest in learning					
	More	20	1	61 (63%)*		
	Remains same	25 (25%)	19	24 (25%)		
	Reduce	50 (50%)	57 (59%)	8		
	Lose interest	4	19	3		
3	Interaction with teachers					
	Increase	31 (31%)	8	38 (40%)	1	
	Remain same	35 (35%)	38 (40%)	40 (42%)*	2	
	Decrease	32 (32%)	41 (43%)	14	6	
	Cannot interact	2	9	4	0	
4	Notes making					
	Easy	31 (31%)	8	69 (71%)*		
	Same as offline	35 (35%)	28 (30%)	14		
	Difficult	33 (33%)	58 (60%)	13		
	I don't write notes	0	2	0		
5	Time management					
	Excellent	17	12	18	0	
	Fairly good	69 (69%)	60 (62%)	60 (62%)	9	
	Scarce	11	20	15	0	
	Poor	2	4	3	0	
6	Support from academic resources				Time spent on preparing academic resources	Energy spent on preparing academic resources
	Increased	46 (46%)	17	69 (71%)*	3	4
	same	19	28 (30%)	15	6	4
	Decreased	32 (32%)	41 (43%)	11	0	1
	Not accessible	2	10	1	-	-
7	Use of technology			Not asked		
	Confident	67 (67%)	46 (48%)		9	
	Lack confidence	24 (24%)	34 (35%)		0	
	Handicapped	3	5		0	
	Inadequate	5	11		0	
8	Final exam performance					
	Better	16	3	35 (36%)*	0	
	Same	55 (55%)	15	28 (29%)	0	
	Poorer	28 (28%)	76 (78%)	30 (31%)	7	
	No idea	0	2	3	2	
9	Future TL mode-I would prefer	Not asked	Not asked		Not asked	
	Complete online mode			9		
	Complete offline mode			72 (74%)		
	Blended (online+offline)			12 (13%)		
	Any mode is fine with me			3		

*Cochran-mantel-Haenszel test with $P<0.05$ was considered statistically significant (using Stata 16 software); $P=0.0000$

Table 2: Comparison of student responses to open-ended questions on strengths of online mode of teaching during first (at the beginning of the course) and second (mid-course) feedbacks.

Themes	Strengths of online mode	No of students who expressed their feedback at the beginning of the course	No of students who expressed their feedback at mid-course
Comfortable	Can learn the subject more comfortably and easily, better understanding	13	5
	Online mode helps students with social anxiety open-up for better interaction	3	4
	Can study at their own pace	1	4
	Can attend class in any situation	-	3
	Nice to study being at home with family	-	3
	Can relax at any time of class	-	2
Ability to use Teaching Learning methods effectively in the online mode	Teaching methods through slides, notes, pictures, and videos are good	-	14
	Teaching is very good and clear/excellent	-	6
	Ppt uploaded are helpful	-	3
	Learning through visualisation is good	-	2
	Good use of technology during pandemic	3	4
Better time management	Time management would be better – saves time for both teachers and students	5	16
	Get more time to study each subject	-	1
Nothing positive	Can be as good as offline classes	9	1
	Nothing positive about online classes	-	7
Added advantages	Online classes coupled with small exams at intervals would facilitate learning	3	
	More informative in using online resources	-	1
	There are possible ways to clarify doubts through more interaction	-	4
	Revision classes are very good clarifying doubts		5

"*Offline mode made the subject easier, I feel more interested to study.*"

"*In offline classes, attention span reduced.distracted easily.*"

Strengths and challenges of blended mode of learning

Students expressed that they had a 'better understanding of the subject' with the blended mode than with the online mode alone, 'online MCQ tests with offline revision sessions helped them study better,' 'learning was more interesting,' 'time management was better' and 'more resources were available.' However, they expressed that it was 'confusing to switch between the two modes of learning' [Table 4].

"*Offline and few online classes helps us to manage time……*"

Faculty perceptions on modes of teaching (*n* = 9)

Faculty response to closed-ended questions (n = 9)

Most faculties felt that online teaching made learning easy was good for time management, and made them confident with the use of technology. However, they felt that it probably decreased teacher-student interactions and would result in poor performance by students in the final examination. The time spent on preparation for classes was almost [Table 2] the same or increased. Some felt it made learning difficult.

Faculty response to open-ended questions

The themes that emerged from the faculty responses on strengths and challenges of the online mode of teaching were similar to those of the student responses.

Strengths of online mode of teaching

Time management

Faculty expressed that time management was better with online teaching.

Ability to use audio-visual aids

They expressed several advantages of using technology like better utilisation of audio-visual aids such as using virtual pointers and stylus. Online classes provide a closer look at the

Table 3: Comparison of student responses to open-ended questions on challenges of online mode of teaching during first (at the beginning of the course) and second (mid-course) feedback.

Themes	Challenges of online mode	No of the students who expressed their feedback at the beginning of the course responses	No of the students who expressed their feedback at the mid-course responses
Technical difficulties	Network issues	16	20
	Lack of access to offline academic resources	8	
	Attending classes using mobile phones is highly strenuous	4	
	Learning/understanding is more difficult with online mode. 'Unexplainably unpurposeful' Although teaching is excellent, inline mode just doesn't work	-	12
Lack of interaction	Difficult to clarify doubts	11	2
	Lack of actual human face-to-face interaction with teachers and classmates/combined studies which contributes to learning	10	10
Learning difficulties	Notes making is a challenge	8	5
	Harder to concentrate easily distracted	8	9
	More effort for students as beginners and teachers as well	8	1
	A subject like physiology requires offline classes	7	8
	Time consuming as we need to put more effort into studying and notes making	2	3
	Language issues	1	
	Loss of interest in studies	-	13
	Reducing confidence	-	2
	Boring	-	1
	At home more enjoying than studying	-	1
	In general offline classes better	2	2
	Get lazy to study	1	1
Health issues	Eye strain and headache (so fed-up)	7	15
No negatives	No negatives	-	4

Table 4: Comparison of student responses to open-ended questions to strengths and challenges of offline mode and blended mode of learning during the end of course feedback.

Strengths of only offline teaching with a number of responses	Challenges of only offline teaching with a number of responses
• Better understanding – 30 • More interest in the subject – 12 • More interaction – 7 • Blackboard teaching is better than PPT–2 • Makes subject easier – 1 • Nothing different from online classes – 17 • Increased concentration – 1 • Making notes easier – 1 • More informative – 1 • Don't take online, only offline is good – 1	• Speed is reduced – 7 • Time management is less – 5 • Distracted easily, attention span is reduced – 2
Strengths of blended teaching with the number of responses	**Challenges of blended teaching with the number of responses**
• Good understanding – 9 • Revision classes were good and MCQs helped revise the topics – 5 • More interesting – 4 • Time management is better – 2 • More resources were available – 1	• Confusing – 6

MCQ: Multiple-choice question

class slides which would help students understand diagrams, videos, animations, and charts better. Students could record lectures (with permission) which would help them revisit the lectures and revise.

Added advantages

Students could attend classes in any situation. One faculty expressed a wider perspective that students could pursue their careers even in a pandemic and applauded the use of technology.

'*Students have the option to attend classes easily even if they are physically ill…. or not in town….*'

Challenges of online mode of teaching

Technical issues

Technical and logistic issues including internet connectivity and distractions at home at the students' end were expressed as the biggest challenges. As most students accessed the sessions through their mobile phones, it was more challenging to check on student attention levels.

Lack of interaction

Despite efforts from both ends, the faculty felt it was a challenge to make the students interact with them.

Learning difficulties

Students' involvement and attention span seemed to have reduced. The above challenges, at times, led to reduced student attendance. It was hard to tell whether students were logging into classes for the sake of attendance or to really learn.

Overall, they expressed that the challenges outweighed the advantages.

'*Many are intended to get the attendance than understand the concepts….*'

Strengths of offline/blended mode of teaching

Many faculty expressed that blended teaching could be a very efficient and economical strategy if sessions were identified for effectiveness in the online and offline modes and segregated to complement each other. The online method could be used to cover easy topics and the offline mode for difficult topics, small group teaching, and practical sessions. This would help in time management, which would serve as a major advantage. They felt that students would become more independent and encouraged to find solutions to their problems.

'*Time is not lost due to unforeseen circumstance; the curriculum can be covered in the stipulated time.*'

Challenges of offline/blended mode of teaching

The general observation of faculty during the offline mode of teaching following a long period of online mode of teaching was that students' attention spans were too short. They also found students more distracted, talking to friends and trying to use their phones and this made them feel dissatisfied as teachers. The faculty felt that due to the possible difference in attention levels in the online and offline modes, the transition may feel abrupt to the students during blended learning.

Feedback on reinforcement measures

In response to closed-ended questions, students and faculty opined that the online upload of the sample practice questions and answers, revision classes, and MCQ tests were 'sometimes' helpful to the students to revise the subject, motivate them to study, and improve their confidence. The number of responses is shown in [Table 5].

Further, in response to open-ended questions to the faculty, some strengths of reinforcement measures were expressed like the reinforcement measures helped students understand the more difficult topics and revise them and that they could orient their learning towards performing well in their exams. The faculty felt that revision classes lead to better student interaction, clarification of doubts, and assessment of student learning in the offline mode when compared to the online mode. However, the revision classes seemed less interactive, for the given setting, after several months of online mode of teaching. A few challenges were also mentioned. Since students were not monitored, they might have answered the online MCQ tests as an open book exam, which does not help improve their confidence. Since the online tests were only MCQs, the students responded to objective questions better, during subsequent offline revision classes; however, they were not very confident in explaining concepts.

'*Students could refresh the topics and also get themselves oriented towards the subject.*'

Objective measures of performance (internal assessments and final summative assessments and results of MCQ tests)

The mean scores and pass percentage, in the university-mandated internal assessments, of students for the academic year 2019–2020 (students had attended only offline mode of physiology teaching) and 2020–2021 (study cohort, i.e., students attended most physiology classes online and had a few offline/blended classes) were compared and were not significantly different. Based on the state university (Rajiv

Table 5: Student and faculty responses to closed-ended questions on reinforcement measures.

Questions and options provided	Number of students who expressed this feedback by mid-course (*n*=96)	Number of students who expressed this feedback by end-of -course (*n*=96)	Number of faculty who expressed this feedback by end-of-course (*n*=9)
The practice questions uploaded online periodically after each chapter is motivating me to revise the respective chapters:			
Always	23 (25%)	21 (23%)	0
Sometimes	54 (56%)	64 (66%)	3
Rarely	17	11	0
Never	2	0	0
The online periodic revision classes are helping me clarify doubts:			
Always	19	37 (39%)*	0
Sometimes	51 (53%)	51 (53%)	2
rarely	24 (26%)	8	1
Never	2	0	0
The intimation to revise for MCQ tests is motivating me to revise the chapters			
Always	35 (37%)	26 (28%)	0
Sometimes	49 (51%)	57 (59%)	3
Rarely	9	11	0
Never	3	2	0
Attempting the periodic online MCQ tests is influencing my level of confidence			
To a great extent	10	11	0
To some extent	67 (69%)	70 (71%)	3
Not make any difference	15	14	0
Reducing my confidence	4	1	0

*Cochran-Mantel-Haenszel test with $P<0.05$ was considered statistically significant (using Stata 16 software); $P=0.0001$. MCQ: Multiple-choice question

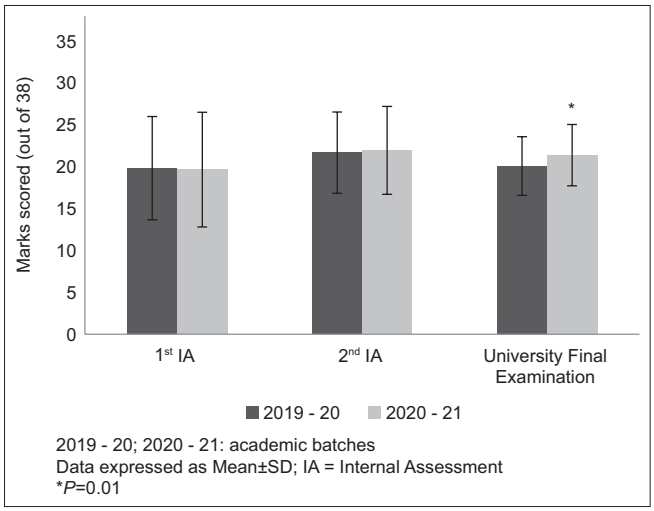

Figure 2: Comparison of objective measures of performance: Internal assessments and summative assessments. SD=Standard deviation; IA=Internal assessment.

Gandhi University of Health Sciences) guidelines, a score of 50% and above for a total of 38 marks is considered a pass. The mean scores of the final University exams of the academic year 2020–2021 (21.41 ± 3.66) were significantly better (P = 0.01) when compared to those of the academic year 2019–2020 (20.09 ± 3.5). The pass percentage of the final university exams of the academic year 2020–2021 was 82%, which was higher when compared to 65% of the academic year 2019–2020.

There was no significant difference in the mean scores of the students, out of 30, in the first (19.55 ± 4.26), second (16.15 ± 4.02), and third (24.19 ± 2.97) MCQ tests that were conducted as reinforcement measures Figure 2.

DISCUSSION

The study was conducted in a nursing college where offline was the only mode of teaching until the pandemic hit. Students and nursing educators were caught unaware and had to evolve, adapting to the online platform with teaching-learning methods modified to suit the needs of the hour.[13,18,20-22]

Unlike several cross-sectional studies that captured 1-time student feedback on the online mode of teaching-learning during the COVID-19 pandemic, our study used the novel approach of capturing student feedback at multiple time points through the academic year. Based on the feedback, several interventions were planned to aid better learning outcomes among students. Faculty feedback was taken as well, which seemed to reflect the same ideas as the student feedback.

As students navigated through the course, their feedback reflected student perceptions as captured by other cross-sectional studies on online teaching during the pandemic.

Among the strengths that students expressed, time management and the liberty to study at their own pace in the comforts of homes emerged as the dominant ones. Both the students and faculty appreciated the use of technology to keep nursing education going through the pandemic and the use of various online tools to keep teaching/learning interesting.[18,19,23,25,27] As the year progressed, an increasing number of students felt that the online mode was more difficult and their confidence in the use of technology is reduced. Poor internet accessibility was the biggest challenge as expressed by both students and faculty. This was reported by similar studies on the delivery of nursing and medical education during the COVID-19 lockdown in many developing countries.[18,23,27-31] In the current study, concurrent to a few others, reduced interest of students in the subject and reduced interaction with teachers were reported by both students and faculty. Students had added concerns related to health, due to stress and constant exposure to screens.[20,23,25] Even among medical students, studies from other countries and a multicentric study in India have shown similar findings in strengths and challenges in the online mode of physiology teaching.[13,23,24,32-34]

Despite the challenges of purely online learning, nursing students wished for online classes to be continued during the pandemic.[13,31,35] However, given a choice, both students and the faculty preferred the offline mode, especially for a subject like physiology. This could be because physiology is perceived to be best understood with both didactic teaching and face-to-face interactive learning, as it provides more opportunities for questions and answers, discussion time, and easier communication with peers and teachers.[13,19] Many other studies have reported students' opinions that online teaching could never substitute an in-class environment of physiology teaching, which was reflected in their learning outcomes.[3,16] However, this study showed that the learning outcomes did not suffer due to online/blended learning. It must be noted that the poor student attitude toward online learning was not a reflection of dissatisfaction with the subject of physiology. The effectiveness of forcing students to consume physiology learning material online, in preparation for a final summative assessment, can be questioned, especially in an era when most online content sought by students is for more relaxing purposes such as entertainment.[3]

With the experience of the blended mode of learning, toward the end of the course, the students opined that it could be a good way forward. The faculty also felt that blended mode could be a good futuristic approach if the offline and online modes could be meticulously planned to complement each other.[19,25] Studies comparing the various modes of learning (offline/online/blended) have shown that blended teaching of physiology showed better student outcomes and student satisfaction, when 'core physiology concepts' are taught offline and 'extension learning objectives' are covered using online activities.[3] With the exposure to this mode of learning, which was new and of short duration, it was understandable that students reported difficulty in switching between modes, a concern echoed by the faculty.

Capturing student feedback on the online mode of learning during challenging times, at 3 time points, enabled the investigators to provide timely feedback to both students and faculty, to aid learning. This approach has been little explored in studies on the online mode of teaching during the pandemic. The concerns raised were addressed by the physiology course coordinators for the BSc Nursing course by encouraging students to maintain a positive attitude, to clarify doubts during online lectures even if they must interrupt the lecture, and to make notes as much as possible. Faculty was also addressed by the course coordinators and briefed on the challenges faced by the students. They were advised to take appropriate measures that were feasible in the given situation.

Extra help to assist students in coping with the new mode of learning was provided in the form of reinforcement measures. Both students and faculty felt that the reinforcement measures had value during the difficult situation and aided learning. The consistent scores of MCQ tests reveal that the students were constantly driven to study in response to the reinforcement measures. However, the faculty expressed that after the implementation of MCQ tests, students seemed more prepared for objective type assessments, rather than explaining concepts in the form of essays. During the pandemic emergency where educators and students struggled to cope, a few studies did show the benefits of extra reading materials and quizzes in the online mode.[24,25]

Their performance in the internal assessments and the final summative assessment, which were the objective measures of student performance, show that the student performance did not match their perceptions and that students were able to cope with the change in learning mode during the pandemic.

Practical

In the pre-pandemic years, the few practical sessions were usually interspersed with theory classes. During the pandemic, they were kept pending anticipating the students' return to campus. This eventually did occur and all practical's were conducted offline. It also allowed the practical demonstrations to be conducted by the staff of the Department of Physiology under more relaxed rules of social distancing.[36]

Blended model

The pandemic threw into sharp relief the need to include online components in the nursing education system in countries like India. Considering the feedback received

Table 6: Physiology blended lesson plan.

Session	Existing offline method	Proposed blended method	
		Offline component	Online component
Didactic lectures			
1. Core physiology topics (75–80%)	Offline lectures	Lecture on must-know concepts	Good to know concepts - Students search for answers to questions/ Faculty upload notes or slides
2. Simple topics/topics based on mere recall (25–30%)		Nil	Lecture
Practical sessions	Live demonstrations	Live demonstrations	Nil/videos on abnormalities related to the practical topic
Reinforcement measures	Hard copies of practice questions and answers are provided after completion of each Physiological system.	Nil	1. Uploading Faculty PowerPoint presentations, practice questions, and answers 2. Periodic revision classes (student's doubts could be clarified).
Assessments			
1. Class tests	Nil	Nil	Periodic MCQ formative assessment tests
2. Internal assessments*	2 exams	2 exams	Nil
4. Final University exam*	1 exam	1 exam	Nil

*Format mandated by the State University. MCQ: Multiple-choice question

from both students and faculty, a blended mode of nursing education seems to be the ideal way forward. This enables the introduction of both students and faculty to the vast number of online educational tools available while retaining the offline mode for its obvious advantages. With the practice of blended learning, there is room to adapt more in either direction (online or offline) as the need arises. With this in mind, we propose a model for blended learning that touches on all components of the curriculum in physiology in the 1st year B.Sc Nursing course [Table 6]. The model is based on the most recently revised curriculum[37] of the university to which the college, where the study was conducted, is affiliated. However, it can be generalised to other curricula, for all pre-clinical subjects.

Limitations

The study was conducted in a single institution and hence generalising the findings could be limited by the background and the ability of students. The confidence of students and staff in the use of technology, electronic media devices, and various online platforms were not explored. All students did not respond to open-ended questions; hence, the themes derived do not represent the expression of all students enrolled in the study. Although several measures were taken to address the students' concerns expressed by mid-course, the impact of the same was not specifically assessed. The blended learning model proposed is based on a single-centre study and needs to be validated with multi-centre studies.

CONCLUSION

This prospective study captured student perspectives on the online mode of learning, on a periodic basis. Student expectations about the online mode of learning were met only in the aspect of time management. Both students and faculty expressed several strengths such as better comfort, effective use of online teaching-learning tools, and effective time management. The challenges expressed were bad network connectivity, learning difficulties, lack of face-to-face interaction, and health issues. Planned reinforcement measures seemed to aid student learning. Efforts were made to address challenges, captured through feedback taken at the beginning and mid-course, by discussion with faculty, and advice to the students in the middle of the course. Even though both teachers and students adapted to the online mode of teaching-learning, both preferred a completely offline mode, particularly for physiology. They opined that a blended mode could be implemented with meticulous planning. The final summative assessment scores showed that online/blended learning could work without compromising student learning outcomes, despite their concerns about the new mode of learning. A blended model for physiology teaching has been proposed which requires further validation.

Acknowledgment

The authors thank the 1st-year students of the BSc Nursing course (academic year 2020–21) for having been a part of

the program and providing feedback. We thank Dr. Ashwini Priyanka V and Dr Pranathi R, Senior Residents, Department of Physiology for conducting the revision classes and MCQ tests. We also thank the faculty of the Department of Physiology for providing feedback as a part of the project. Our deepest gratitude to Dr Mario Vaz, Professor of Physiology for his input and critical review of the manuscript. Our deepest gratitude to Dr John Stephen, Professor of Dermatology, Professor and Head of the Department of Medical Education, and Vice Dean-Postgraduate for the critical review of the manuscript. We also thank our statistician Dr Tinku Thomas, Professor and Head of, the Department of Biostatistics for conducting the required statistical analysis.

Declaration of patient consent

Institutional Ethics Committee (IEC) permission obtained for the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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How to cite this article: Savitha D, Kumar S, Anto T. Online physiology teaching for nursing students during the COVID-19 pandemic – strengths, challenges and reinforcement measures. Indian J Physiol Pharmacol. 2024;68:86-99. doi: 10.25259/IJPP_304_2023