

Medical Education

## Implementation of the online learning management system 'Moodle' as a blended approach to online teaching

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### ABSTRACT

**Objectives:** Web-based learning is becoming a newly accepted standard in education, more so with COVID-19 pandemic. To use technology to redesign learning experiences, a blend of synchronous and asynchronous approaches was used wherein the routine lectures through MS Teams (synchronous) were integrated with an online learning management system (LMS), 'Moodle' (modular object-oriented dynamic learning environment) based, four-quadrant approach (asynchronous). We aimed to determine the student's engagement, performance and perception of the new online LMS.

**Materials and Methods:** All 170 students of the 1<sup>st</sup> year MBBS of batch 2020 were enrolled in the course. A module was developed for teaching 'Physiology of Vision' with this blended approach. Along with routine online lectures through Microsoft Teams, supplementary materials in the form of multimedia presentations and additional links to useful websites were provided through online LMS. The online activity of students was recorded and assessments were done. A feedback form was filled out by students at the end of the course.

**Results:** A significant positive correlation of examination scores with individual student's activity logs and significantly better scores in top Moodle users along with significantly higher marks in Moodle-based modules than in other modules confirmed the value of Moodle in improving student performance. Overall feedback from students was clearly in favour of implementing Moodle as a complementary tool to traditional teaching.

**Conclusion:** Moodle improved the quality of learning. It developed interest and motivation among students and has a positive impact on academic outcomes.

**Keywords:** Blended learning, Computer-assisted learning, Moodle, Online learning management system, Asynchronous learning

### INTRODUCTION

Online teaching became an important means of education during the COVID pandemic, leading to a massive change in medical education and pedagogy. The internet is perceived as one of the most important sources of new information and web-based learning is becoming a newly accepted standard in the process of education.<sup>[1]</sup> There are constant efforts by educators worldwide to search the innovative ideas for supplementing medical education using web-based learning.<sup>[2]</sup> Indian students have shown a very high number of enrolments in Massive Open Online Courses (MOOCs) worldwide.<sup>[3]</sup>

Student engagement is an ongoing concern for educators more so with the online platform.<sup>[4]</sup>

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Blended learning is a style of education in which students learn through electronic and online media as well as traditional face-to-face teaching. Due to the lockdown, face-to-face teaching was not possible. Hence, the blended learning approach used by us was the routine online teaching through Microsoft Teams taken in our institute (synchronous), supplemented with a web-based learning management system (LMS) – Moodle (modular object-oriented dynamic learning environment) (asynchronous). The synchronous format is useful for introducing new topics, discussing complex ideas and challenging work, and promoting collaborative learning and student-teacher interactions.<sup>[5-7]</sup> One of the disadvantages of the synchronous format is that students might find it difficult to remain engaged for long durations. Asynchronous learning could be used to reinforce what was taught and discussed during synchronous sessions and for tasks and activities that can be self-paced and that might require more time to complete, such as long-term projects. Asynchronous learning also has the advantage of promoting student self-regulation and a sense of control over the learning process, factors known to increase student engagement.<sup>[8]</sup> A blended approach is reported to increase student engagement and has a positive impact on the academic outcome.<sup>[3]</sup>

Moodle – an online LMS – is one of the common web-based learning platforms.<sup>[9]</sup> It has numerous known advantages compared to routine lectures. It increases flexibility in the time and place, thus creating an independent learner.<sup>[10]</sup> It has the potential to improve communication among students and between students and the course instructor. In addition, it develops critical thinking through the use of multimedia presentations and additional links to useful websites.<sup>[9]</sup> Assessment features have various options to grade them timely with instant feedback available to students. This makes learning quite interesting and helps students solve their queries more efficiently.<sup>[11]</sup>

It has been felt that the technology should be used to redesign learning experiences and not just replicate offline experiences online.<sup>[12]</sup> Learning science research shows that students understand and remember important ideas much better when they revisit important ideas multiple times.<sup>[13]</sup> There are various studies on Moodle as a blended approach to teaching from the Western world but very few from developing countries. The literature is deficient in the use of Moodle in MBBS teaching in India. Considering the need for an hour, we planned to integrate these innovative networking tools to improve educational experiences. We created a teaching module on 'Physiology of Vision' on this blended approach. Our objectives were to study the effectiveness of Moodle as an education management tool, in terms of student engagement, performance and perception.

## MATERIALS AND METHODS

### Online course setup and administration

MBBS (Bachelor of Medicine and Bachelor of Surgery) programme offered in India is a 4.5 years course with 1 year of internship, and the subject of physiology is taught in the 1<sup>st</sup> year. It is traditionally taught through lectures, tutorials and practical sessions, all of which involve face-to-face interactions with students. Due to the COVID-19 lockdown, the teaching shifted to online mode. Our institute used MS Teams as an online platform for distance teaching. We supplemented the 1 week of online teaching with a blended learning course on the module named 'Physiology of vision'. The course content on Moodle was accessible to students for 2 more weeks after the completion of live synchronous classes. All the 170 students of the 1<sup>st</sup> year MBBS of batch 2020 at University College of Medical Sciences, Delhi were enrolled in the course. Out of them, 161 students registered on Moodle. Students were free to use Moodle at their will.

### Course creation

The course named 'Physiology of vision' was created using the online LMS 'Moodle' using the four-quadrant approach<sup>[14]</sup> along with routine online lectures through MS Teams to make a better understanding of the functioning of our eyes. We can create our course on Moodle through Gnomio, a free hosting service for Moodle. The same faculty who was taking online lectures on this topic herself created the course on Moodle.

The module was uploaded into six topics (T1–T6) with their expected outcomes. Supplementary material was provided in the form of short videos of 5–10 min duration along with lecture reading materials in the form of PowerPoint and electronic pages under the six main topics of the module. [Table 1] shows the topics covered and the supplementary material used in them.

The four-quadrant approach used in the module was as follows:

- Quadrant 1 was prepared with supplementary videos of 5–10 min duration. We did not include the core video as regular MS Teams classes were going on
- Quadrant 2 consists of supplementary materials in text form including PDF research papers, journal articles, books, images and links to videos
- Quadrants 3 and 4 were for discussion forum and assessment, respectively, for motivating, engaging and encouraging the learner.

The Open Educational Resources (creative commons) videos were shared from YouTube through embed code so that only that particular video will be open for the students and they will not get distracted by many videos available on YouTube.

**Table 1:** Topics and supplementary material.

S. No.	Topic	Supplementary material used
1	Functional anatomy of the eye	Electronic page on the brief discussion on vision and a supplementary video on the anatomy of the eye
2	Optics – image-forming mechanism	A downloadable PowerPoint in PDF format describing the refraction, functioning of reduced eye and mechanism of accommodation was uploaded
3	Visual pathway and visual cortex	A video describing the anatomy of the visual pathway
4	Colour vision	An electronic page named ‘mystery of colours’ describing historical aspects and colour opponent theory of colour vision along with a supplementary video and PowerPoint on theories of colour vision was made available on student’s demand
5	Photoreceptor mechanism – phototransduction	A video describing the generation of receptor potential in the photoreceptors along with an electronic page describing the photoreceptor mechanism
6	Processing of visual signals	An electronic page on the mechanism of bipolar cells response, describing the functioning of on-centre and off-centre bipolar cells was shared by hearing the student’s doubt during online lectures

Resources were uploaded in the form of electronic pages with recorded audio, videos with embed code, images and hyperlinks text to enhance student learning.

### Consent and users enrolment

All the students of the 1<sup>st</sup> year MBBS of batch 2020 participated in the study after obtaining written informed consent. The study was approved by the Institutional Ethical Committee (IECHR-2021-50-21 dated 16 September 2021). We collected the information for user ID by sharing the Google Forms with students. They were asked to fill in their first name, last name and email id. Excel file was converted into Comma Separated Values (CSVs) format and uploaded on Moodle. Uploaded users were assigned the role of students in our course ‘Physiology of Vision’ and they received the Moodle login credentials through an email from Gnomio. After login, an introductory video on how to use Moodle was available for the participants. This was followed by course information in the form of topics covered in the course, course objectives, course outcome, assessment methods and discussion forum.

### Interaction with the students

Students were informed about new uploads by announcing each resource uploaded in the announcement section.

### Assessment

Formative assessments were taken in the form of case-based questions with feedback answers and review quizzes in the form of various application based and a few recall types of questions.

### Subjective assessment

An announcement was made a day before the assignment and downloadable case-based questions were open for the students for 3 h. After the closing of the assignment, downloadable feedback answers were made available to the students.

*Quiz.* The feature of the quiz on Moodle is a fair facility to assess with instant feedback. The quiz consisted of a few recall and more application-based multiple-choice, matching and true/false questions from the topics taught in the classes. The value of the grades ranges from 0 to 10, out of which 5 was the minimum passing grade. The quiz was designed in a way that students can attempt each question only once and there was shuffling of questions for every user. The quiz was opened for 1 h on Moodle. All the submissions were available in a downloadable CSV file, consisting of individual student’s grades and the time taken by them for completion of the quiz. Students can also see their marks and feedback answers given by the teacher after the closing of the quiz.

### Summative assessment

The final summative assessment of students was taken at the end of the course in the form of a comprehensive viva voce by all physiology teachers of the department.

### Discussion forum

The discussion forum started with a few case studies and student’s queries. The discussion forum has a feature of sending an instant email notification to all the users including the teacher for every new post, to make them aware of the queries raised by the students and their replies to them.

### Grading

Grading of formative assessments of case-based short questions and quiz was made available for the students on the Moodle site.

## Evaluation methods

### Online activity logs

Activity logs of each student were generated on Moodle and the download was in a CSVs file. After opening the data in the Microsoft Excel worksheet, it was analysed offline. The online activity of students was calculated based on the total time spent by each student on the Moodle platform and the total number of clicks, students made on the site for accessing the course content during this time.

### Examination scores

The scores of summative assessments and quizzes were tabulated. For this study, marks in the summative assessment of this topic (Physiology of Vision) were correlated with the activity logs of individual students. To assess the academic performance of high and low Moodle users, we also compared the examination marks of the top 30 users with those of the bottom 30 users. Finally, to evaluate the value of Moodle in improving student examination performance marks obtained by the students in this module (Moodle based) were compared with marks obtained in other modules which did not use Moodle. The Moodle usage pattern (to see time spent on Moodle and number of clicks) was compared for high and low achievers based on non-Moodle-based examination scores and Moodle-based examination scores separately. This was done to analyse whether high achievers in all previous examinations have a tendency to explore new LMS and thus have got better scores in this Moodle-based module also.

### Questionnaire

After the completion of the module, a Google Forms link was shared in the student's WhatsApp group to fill out the feedback questionnaire related to their experience and expectations on the use of Moodle. The questionnaire enabled students to evaluate various elements of Moodle, including its accessibility, ease of use, content and ability to facilitate student-student/student-teacher interactions using a 5-point Likert scale.

### Statistical analysis

Pearson's correlation test was used for correlation between formative and summative assessments. Spearman's correlation coefficient ( $\rho$ ) was used, where the variance of data was large such as time spent on Moodle and number of clicks. Paired *t*-test was used for comparing the examination scores of different modules and an unpaired *t*-test was used for comparison between top 30 and bottom 30 Moodle users and also between high and low achievers. The data were analysed using SPSS version 20.0. The significance level was set at  $P < 0.05$ .

## RESULTS

### Student's participation

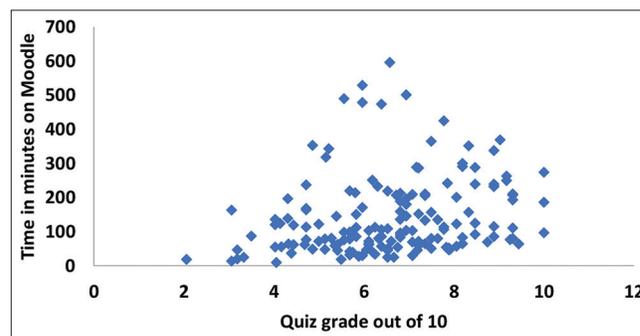
Students of the 1<sup>st</sup> year MBBS 2020 batch, consisting of a total of 170 students, were enrolled in the course. After analysing their activity logs, we found except for 9, the rest 161 students accessed Moodle site. Out of them, six students were absent from the various tests and were excluded from the study. These 155 students (91% of the total) spent 22,367 min and made a total of 16,410 clicks for accessing various features available in the course offered to them. The average time taken for quiz completion was 24.34 min by 155 students who participated in the quiz. It was observed that those who received lower grades completed the quiz earlier. A total of 113 students uploaded their answers for the given assignment of case-based questions.

### Examination scores and activity logs

We correlated the marks obtained by individual students in the quiz and summative examination with activity logs on Moodle. There was a statistically significant positive Spearman's correlation coefficient ( $\rho$ ) of 0.306 ( $P = 0.000$ ) with quiz grades and time spent on Moodle [Figure 1] and of 0.302 ( $P = 0.000$ ) with summative examination scores and time spent by an individual student on Moodle [Figure 2]. Significant positive Spearman's correlation coefficient ( $\rho$ ) of 0.284 ( $P = 0.000$ ) and 0.261 ( $P = 0.001$ ) was also found between their corresponding clicks with quiz grades and summative examination scores, respectively.

We found a significant positive correlation ( $r = 0.364$ ,  $P = 0.000$ ) in the online formative examination (quiz grades) with summative examination scores [Figure 3].

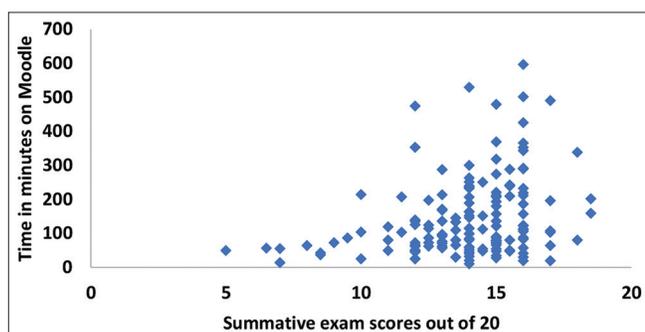
Based on the time spent on Moodle, the top 30 users took a longer time to complete the quiz but obtained higher grades when compared with the bottom 30 users. The summative examination score was also significantly higher among top Moodle users [Table 2-I]. Similar significant results were



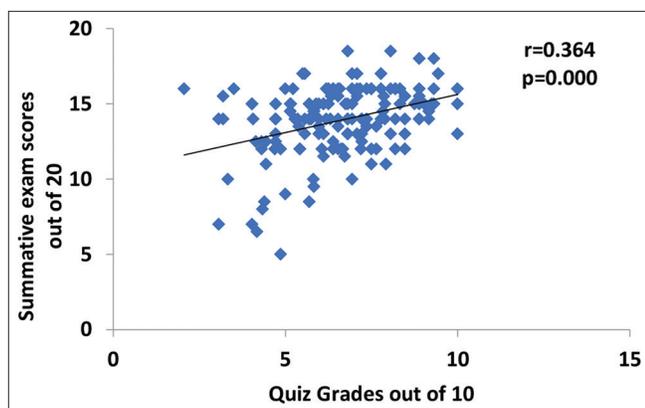
**Figure 1:** Spearman's correlation of 0.306 ( $P = 0.000$ ) between quiz grades and time spent on Moodle.

observed when the top 30 students were compared with the bottom 30 students based on the number of clicks [Table 2-II].

We compared the high achievers (top 30 students) and low achievers (bottom 30 students) based on the previous non-Moodle-based examinations to see their Moodle usage pattern and also their performance in Moodle-based examination [Table 3-I]. There was no significant difference either in Moodle usage (time spent in minutes on Moodle) or in the number of clicks among high and low achievers. Both the groups have used Moodle and high achievers performed significantly better in the Moodle-based module also.



**Figure 2:** Spearman's correlation of 0.302 ( $P = 0.000$ ) between summative examination scores and with time spent on Moodle.



**Figure 3:** Pearson correlation between quiz grades (formative examination) and summative examination scores.

To see the effect of the usage of Moodle on student's performance, we compared high achievers (top 30 students) and low achievers (bottom 30 students) based on the marks obtained in module taught by Moodle. High achievers have shown significantly higher use of Moodle both based on time spent in minutes and number of clicks [Table 3-II].

Examination score of Moodle topic was significantly higher as compared to other topic scores in which Moodle was not implemented [Figure 4].

### Student's feedback

The information was gathered by the presentation of statements to which students were invited to respond on 5-point scales which have been collapsed down to 3-point scales. We received 122 responses (78%), wherein most of the students agreed that access to Moodle was simple and they were happy and satisfied with the use of Moodle. Student's responses to the feedback questionnaire are compiled in [Table 4].

### DISCUSSION

This study is an initiative to analyse the effect of the new online LMS, 'Moodle' in terms of student engagement, performance and perception.

### Student's participation

Most (91%) of the students were interested in the integrated approach to teaching, as shown by their activity logs on Moodle. It was noted that students were more active on Moodle site before their examination but they continued accessing the course content on Moodle after the examinations got over. This shows that students find it beneficial to read the topic from Moodle platform along with online classes.

We also found a significant positive correlation between time spent on Moodle and corresponding clicks. In an earlier study, it was shown that page hits were predictors of success.<sup>[15]</sup> In a blended learning approach using Moodle,

**Table 2:** Comparison of top 30 Moodle users with bottom 30 Moodle users based on time spent on Moodle and number of clicks.

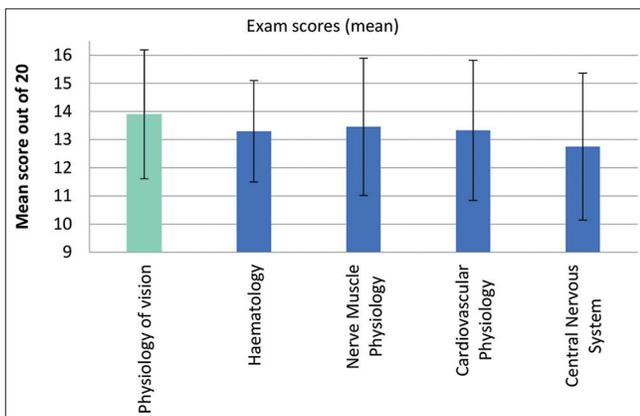
I	Based on time spent on Moodle	Top 30 (mean±SD)	Bottom 30 (mean±SD)	P-value
	Quiz time	26.53±8.431	20.93±7.887	0.01
	Quiz grade/10	7.166±1.854	5.97±1.877	0.016
	Summative examination score/20	14.967±1.351	12.983±2.863	0.001
II	Based on the number of clicks on Moodle	Top 30 (mean±SD)	Bottom 30 (mean±SD)	P-value
	Quiz time	26.53±7.687	21.27±7.4000	0.009
	Quiz grade/10	7.186±1.569	5.825±1.647	0.002
	Summative examination score/20	14.500±1.38	12.967±2.879	0.011

**Table 3:** Comparison of high and low achievers.

I	Based on the previous four examinations	High achievers (mean±SD)	Low achievers (mean±SD)	P-value
	Examination score out of 80	62.43±1.715	42.65±3.941	0.000
	Moodle usage (minutes)	177.96±120.123	125.93±101.514	0.075
	Number of clicks in Moodle	118.8±69.321	95.7±49.768	0.144
	Eye viva score out of 20	15.1±1.234	11.9±2.666	0.000
II	Based on Moodle-based module	High achievers (mean±SD)	Low achievers (mean±SD)	P-value
	Examination score out of 20	16.5±0.809	10.36±2.038	0.000
	Moodle usage (minutes)	223.03±146.806	73.68±49.181	0.000
	Number of clicks in Moodle	139.62±82.576	77.31±31.208	0.0006

**Table 4:** Result of feedback questionnaire from student's responses.

Questionnaire	Disagree	Neutral	Agree
1 The registration process was simple	2.4	13.9	83.6
2 Access to Moodle using a username and password was simple	5.7	11.5	82.7
3 An introductory video on how to access Moodle was useful	4.9	19.7	75.4
4 It was easy to access various features offered through Moodle	11.5	23	65.5
5 Lecture material on Moodle was appropriate, relevant and useful	2.5	9.8	87.7
6 I was happy and satisfied to use Moodle	8.2	15.6	76.3
7 PowerPoint and other uploads were easily downloadable	3.3	24.6	72.1
8 It added extra interest in the topic to view the supplementary videos, PPTs and text materials on Moodle along with regular classes on the same topics on Microsoft Teams	7.3	13.9	78.7
9 Moodle is complementary to regular online MS Teams classes	2.5	17.2	72.1
10 Queries that were asked in the class were addressed promptly and effectively by resource materials uploaded on Moodle	2.5	17.2	80.3
11 The quiz and assessment were fruitful on Moodle, as explanations in the form of feedback were available after the submission of the assessment	1.6	16.4	81.9
12 The teacher provided her feedback on test results efficiently and promptly	1.6	11.5	86.8
13 The use of Moodle along with regular classes gave an excellent platform for self-paced independent study	9.8	20.5	69.7
14 Moodle improved my interaction with other students	31.2	32.8	36.1
15 Moodle improved interaction between students and teacher	15.6	18	66.4
16 Moodle helps understand topics taught in online classes	2.4	18	79.5
17 Information technologies complement traditional ways of teaching in an excellent way	7.4	22.1	70.5
18 Microsoft Teams online lectures can be completely replaced by Moodle	36.9	23.8	39.4
19 Department of physiology should make more modules using Moodle	13.1	19.7	67.2
20 Other departments in the MBBS curriculum should also use various features of Moodle for more efficient delivery of their course materials	14.7	23.8	61.5

**Figure 4:** Comparison of examination scores of Moodle-based examination (Physiology of Vision) with other non-Moodle-based examinations.

participants' interest and increased ratio of E-learning time to internet time are also reported.<sup>[16]</sup>

### Student's performance (Examination scores and activity logs)

A significant positive correlation in formative and summative examination marks with Moodle log activity shows the role of Moodle in improving student's overall performance. This is in concurrence with other studies which reported that access to Moodle platform was associated with improvement of knowledge and higher scores by students.<sup>[17-19]</sup> It was observed that higher Course Management System usage in terms of page hits (clicks), than posts in the discussion forum, correlated with better student examination performance.<sup>[15,20]</sup> Some researchers did not find an association between

improvement in academic performance with the increased frequency of Moodle use.<sup>[10,21]</sup> However, they found a positive impact on the academic performance of students with the introduction of Moodle and suggested the acceptance of Moodle by all students (low and high achievers) with a similar level of interest and motivation. Our results are consistent with their findings as high achievers in the previous non-Moodle-based examinations did not show an increased frequency of Moodle usage irrespective of their consistently higher scores in Moodle-based module [Table 3-I].

We found a positive correlation between formative assessment and summative assessment corroborating with other studies,<sup>[19,22,23]</sup> in which formative assessment was the most consistent parameter, showing a significant positive correlation with final examination grades<sup>[19]</sup> and the online quiz was associated with improvements in summative examination scores.<sup>[23]</sup>

On comparing the top 30 Moodle users with the bottom 30 users, the former scored significantly higher grades in the quiz and summative examination.<sup>[15,16,18-20]</sup> Students scored significantly higher marks in Moodle-based module in comparison with the marks obtained in other modules which did not use Moodle. Some of the modules were taught by the same teacher. This confirms that the implementation of Moodle is complementary to better examination performance in the module, irrespective of whether it is taught by the same teacher or another. Our findings are in line with a previous study, in which significantly higher examination scores were found in the year of implementation of Moodle than the previous year's scores when Moodle was not implemented.<sup>[24]</sup>

The feature of instant feedback and grading available to students also motivates them for better examination preparation as seen in other studies.<sup>[10,25]</sup> Dobson stated, that in addition to providing valuable feedback to the students about how they are doing, online quizzes may be used by the teachers to identify and help those students who are most likely to perform poorly on the summative examinations.<sup>[22]</sup> Earlier studies have shown that students who participated in both face-to-face on-campus classes and asynchronous online learning opportunities were more engaged than students who only attended face-to-face classes. In addition, the findings show that participation in the asynchronous setting relates significantly and positively to students' academic outcomes.<sup>[4]</sup>

### Student's satisfaction

Student feedback on the new blended approach was very high and most encouraging for the first implementation of such a curriculum modification. An earlier randomised trial also suggests that a blended teaching approach that uses video assignments stimulated interest in the topic and foundational

knowledge, and was more effective for science education than traditional approaches.<sup>[26]</sup> The blended learning approach facilitates access to learning materials and enables time-independent learning.<sup>[27]</sup> Moodle was reported as a preferable platform supporting students' self-learning within a PBL (problem-based learning) curriculum.<sup>[28]</sup> Similar to other studies, students recommended the future use of Moodle in physiology courses and also supported the use of Moodle in other medical subjects.<sup>[21,24]</sup>

### Moodle quiz as a formative assessment tool

Features of assessments including quizzes were very fruitful on Moodle and students liked it. As suggested by Chang *et al.*,<sup>[29]</sup> individualised education is possible in LMS and by analysing the quiz results. Peerapolchaikul *et al.* also found a stronger positive Spearman's correlation between 'Prefer doing quizzes in Moodle to in classroom' and 'Moodle enhances learning capability' in line with our study.<sup>[28]</sup>

### Moodle as a substitute to traditional teaching

Most students did not support Moodle, as a substitute for traditional teaching. E-learning focuses on only the output of the change rather than on the process of the class.<sup>[29]</sup> In addition, students are very much familiar with traditional face-to-face teaching, in which they feel free to raise their queries in real-time as seen in our online lectures also.<sup>[24]</sup> The thought of completely substituting traditional face-to-face teaching by Moodle or any other LMS is apprehensive for students as they may feel disconnected from the real classroom environment and it seems to be justifiable also.<sup>[24,30]</sup>

### Discussion forum as an interactive tool

Moodle also improved communication with the teacher but not much among students. Seluakumaran *et al.* found that the forum feature was most frequently accessed among all features offered through Moodle.<sup>[24]</sup> However, the students still reported that Moodle did not improve their communication. Ramos and Yudko also stated participation in the online discussion requires a great commitment of time.<sup>[15]</sup> To use the Moodle platform to the highest benefit, instructors need to upgrade its capabilities, especially in the area of student-teacher interaction.<sup>[28]</sup>

The discussion forum feature was not very successful in our course maybe because Microsoft Teams classes were ongoing on the same topic and their queries were solved in the class itself and related content was also made available to the students by uploads on Moodle. Still, we received queries in the discussion forum and were solved efficiently by the teacher as evident in the student's feedback.

### Limitations of the study

The major limitation of our study is the absence of a control group. The educational intervention was created based on the original teaching plan of the department. Dividing the participants into two groups to acquire a comparative teaching outcome of blended learning versus traditional learning would have been better.

### CONCLUSION

The integration of Moodle in physiology teaching improved the quality of learning. It developed interest and motivation among students. Moodle gave students a platform for self-paced independent study in a much more flexible way. This technology can redesign learning experiences making them more interesting and effective.

### Acknowledgment

We would like to acknowledge our students for participating in the study.

### Declaration of patient consent

Patient's consent not required as there are no patients in this study.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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