An Online Undergraduate Medical Examination conducted using the Learning Management System - Moodle 3.9 (A student centric Observational Study).

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Running title-Moodle as a Learning management system in conducting online medical examinations

Abstract

Background: With the advent of the coronavirus pandemic, Higher Education Organizations (HEOs), including medical schools, started using online education to effectively teach, and evaluate students' performances. An increasingly popular contemporary modality offered by the digital e-learning market is a Learning Management System (LMS).

Aims and Objectives: The aim isto assess Moodle v. 3.9 as a tool to conduct online medical examinations. The objectives are: 1. To collect student feedback 2. To discuss technical aspects with Moodle experts 3. To implement necessary changes based on the feedback and discussion

Material and Methods: A short-term longitudinal observational study was conducted at the Symbiosis Medical College for Women, Pune, India to collect feedback from 143 students with regards to their online exam experience with Moodle and the technical difficulties they faced were noted. In collaboration with software experts, certain technical changes pertaining to bandwidth requirements were implemented.

Results: We observed that the students require extra time as compared to the online exam scenario for conversion of their answer sheets into PDFs, and this technical aspect needs to be considered while designing such exams. We also established the server bandwidth that is essential for an uninterrupted online exam experience at the institute level. Lastly, student feedback suggested that the online examination environment is perceived as more stressful, compared to its live counterpart.

Conclusion: We conclude that cost-effectiveness, user-friendly interface, and a multitude of assessment-related features make Moodle an efficient tool for conducting online medical examinationsattheundergraduatelevel.

Keywords: Online education, e-learning, online examinations, Learning Management Systems, Moodle, student feedback, medical examinations.

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Introduction:

With the advent of modern pedagogy, Higher Education Organizations (HEOs), including medical schools, started recognizing the benefits of adopting and practicing various principles of Information and Communication Technology (ICT) in order to effectively teach, test, and evaluate students' performances [1]. When World Health Organization (WHO), on March 11, 2020, declared the COVID-19 outbreak as a global pandemic, amongst various robust interventions to prevent the transmission of the virus, governments all over the world called for shutting down of educational institutes [2]. India, with its rapid rise in cases, was no exception. This move stimulated a much-needed paradigm shift in the education landscape, from the traditional face-to-face live classroom setting to an online method of teaching and learning. Also termed as 'distance learning,the application of such internet-based education at an institutional level has proven beneficial to numerous organizations [3].Of the various ICT methodologies to facilitate effective Online Medical Education (OME), an increasingly popular contemporary modality, under the vast umbrella of e-learning, is a Learning Management System (LMS). The digital market offers primarily two types of LMS software: commercial, cloud-based, and free, open-source. Open-source software includes Moodle and Totara Learn and these differ from the commercial, cloud-based software such as Edmodo, Docebo, and Adobe Captivate Prime, by being more easily modifiable to suit the interests of the users, amongst other facets [4]. As reported by Stankovic et al (2017), one of the most frequently used LMS software is Moodle or Modular Object-Oriented Dynamic Learning [5]. Moodle is a customizable, open-source platform that currently has over 270 million registered users across more than 245 countries. With 36 million courses, 4.9 billion quiz questions, diverse administrative features, and a student-friendly interface, Moodle is one of the world's leading learning management systems, with over 7,200 registered sites in India. Previous research has concluded that Moodle's cost-effectiveness and high utility tools aid in enhanced learning and systematic evaluation of students' results. This has been observed in HEOs imparting education across various disciplines including engineering, medicine, and social sciences[6,7]. When it comes to setting up exams, Moodle offers a wide range of applications. Time-based quizzes and assignments, systematic collection and storage of submissions, and the ability to annotate and grade student responses are a few of the key features that make this LMS a teacher-friendly software for designing tests and assessing student performances. Hytönen et al (2020) recently collected students' feedback on a modified Objective Structured Clinical Examination (OSCE) conducted at the national level over Moodle [8].No studies have been carried out in view of addressing the students' perspectives on online examinations conducted over Moodle in India**.** This article reports on a cross-sectional study, conducted at an institutional level, which surveyed the undergraduate medical students of Symbiosis Medical College for Women, Pune, India regarding their experiences of appearing for online examinations conducted via Moodle version 3.9. The study aims at systematically evaluating the technical challenges faced by the students while giving the exam. It also discusses possible solutions based on inputs from Moodle software experts, that would ensure a smoother implementation of such examinations in the future.

Materials & Methods:

This was a longitudinal observational study that assessed the use of Moodle Version 3.9 for conducting the Internal Assessment Examination of a Phase 1 MBBS Batch (2020-21) of one hundred and fifty students at Symbiosis

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Medical College for Women (SMCW), Pune, India. Institutional research Committee approval has been obtained for the study (SMCW/IRC/Fac Res/52/2022).Written informed consent was taken by including it as the first question on the anonymous pre-study questionnaire that was distributed. It was clarified that the students' responses would be used for analyzing the efficacy of the online exam, and not their academic performance. One hundred and forty-three students who consented to be a part of the study were included. Feedback was collected over 3 tests conducted over 3 days. Moodle Version 3.9 is the official LMS that SMCW uses for its online education. Moodle 3.9 version was released by Moodle on 15th June 2020. The institute has a Shared server with the SMCW website and Internal software with a total bandwidth of bandwidth 310 Mbps. The server configuration is CPU - 3VCPU, RAM:- 16GB Harddisk:- 2TB. A new course category titled Online Examination Hall was created on the "Site Home" page of the interface. A total of 3 tests were designed as separate courses under this category: (1) Mock Practice Examination (MPE), (2) Anatomy Internal Assessment Examination (AIAE), and (3) Biochemistry Internal Assessment Examination (BIAE). Student feedback was collected through a Google Forms feedback questionnaire after each of the three tests. Each of these had the same basic pattern (Table 1). The format of the examinations as well as all related instructions were explained over a Zoom™ session to all students. An instructional booklet, as well as a step-by-step explanatory video, was uploaded in the Online Examination Hall course category. The MCQs were designed using the Quiz feature on Moodle. The quiz was scheduled to open exactly at the time of commencement of the test. All the instructions for students were written in the description section of the quiz. All MCQs were four choices-single response types. Every correct response carried one mark each. The student used the Next and Previous buttons to navigate through the quiz. The "Shuffle within questions" option was turned on and the options were left unnumbered. The total number of MCQs, number of pages with an equal number of MCQs on all pages, and time limit for the 3 tests were as follows: (1) MPE: 4 MCQs, 4 pages, 5 mins; (2) AIAE: 40 MCQs, 4 pages, 50 mins; and (3) BIAE: 40 MCQs, 1 page, 50 mins, respectively. (Table 2.) The essay-type questions, namely single liner (SL), short answer question (SAQ), and long answer question (LAQ), were uploaded as a PDF on the Assignment feature of Moodle. Students were instructed to download the PDF, write the answer to the question asked on a ruled A4 sized paper using a pen (writing) and pencil (drawing), click a photograph of the answer sheet and upload it as a single PDF file using the "Add a Submission" option. In every case, extra time was given for the JPG to PDF conversion. (Table 2.) The distribution of essay questions for each of the 3 tests was as follows: (1) MPE: 1 SAQ; (2) AIAE: 10 SLs, 5 SAQs and 3 LAQs; and (3) BIAE: 10 SLs, 5 SAQs, and 3 LAQs. (Table 2.) Using the "Restrict Access" feature in Settings, it was ensured that the examination material was visible only for the test duration window, after which student access was restricted. PDFs submitted after the allotted time were considered as late submissions. The server bandwidth used for the tests were as follows: (1) MPE: 200 Mbps; (2) AIAE: 200 Mbps; (3) BIAE: 2

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Statistical Analysis:

All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean±standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries and diagrammatic presentation. Chi-square (χ^2) test was used for the association between two categorical variables. If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as not statistically significant. Data were analyzed using SPSS software v.23(IBM Statistics, Chicago, USA)and Microsoft office 2007.

Results & Discussion:

Three important observations deserve mention before elaborating on the results of this study. The first one is the attrition in sample size over time, the second one being a gross underestimation of the server bandwidth required for smooth conduction of an online examination of a batch of one hundred and fifty students, and the last one suggesting that the students perceived the online examination environment as more stressful, compared to its live counterpart. The examination conducted of both MCQs and Essay type comprised of 40% and 60% marks each. Examination format details depicted in table 1. A total of 143 students had participated in the study by filling out the pre-study questionnaire (Fig 1). While all participants filled in the post MPE feedback, only 93 (65%) students responded to the AIAE feedback, which further reduced to 72 (50.3%) students in the BIAE feedback. With regards to the students' need for a time extension due to the technical difficulties faced, it was seen that WiFi network issues occurred to the greatest extent in the AIAE, with 23.8 % requesting an extension in time. It was collectively agreed upon by the institute's authorities that every student takes personal responsibility for the efficient functioning of their WiFi network. A significant improvement in this situation was observed in the BIAE, with only 8.3% of students facing WiFi network problems. When it came to the conversion of answer sheets into PDF, the percentage of students requesting time extensions was 9.8 % in MPE, 14% in AIAE, and 6.9% in BIAE. A possible explanation for the rise observed in AIAE is that the number of pages in the AIAE answer sheet was much more than MPE, due to an increase in the total number of questions. The students may thus have misjudged the amount of time required for this conversion based on their MPE experience. Statistics in the Fig 2 & Fig 3 showed that the biggest technical challenge in the examination occurred in the last 20 minutes of AIAE when students were trying to upload their PDF answer sheets on the LMS. The server crashed multiple times and the students could not submit their PDFs even after recurrent attempts to refresh and reload the webpage. However, after an intervention of bandwidth was made, increasing it from 200 Mbps in AIAE to 250 Mbps in BIAE, the percentage of students facing this problem drastically reduced from 61.3% in AIAE to 13.9% in BIAE. Regarding the comparison with a live examination setting, the percentage of students who found the LMS examination experience more stressful was 44.8% in MPE, 53.8% in AIAE, and 31.9% in BIAE (FIG 4). Both the increased server bandwidth provided by the software engineers and a better judgment of estimated time for PDF conversion by the students could be the reasons responsible for the reduction in this percentage in BIAE.

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Conclusion:

Cost-effectiveness, user-friendliness both for the teacher and the student, and availability of multiple exam-oriented features make Moodle an efficient LMS to design and execute online examinations and assess student performances in HEOs. For the teacher, collaborating with Moodle experts and establishing guidelines concerning technical specifications such as server bandwidth can enable a smoother implementation of such exams. For the student, attempting mock tests on Moodle frequently would enable quicker acclimatization to the online examination scenario. As for the decline in feedback with time, students need to be informed of the importance of their feedback during these testing times of transition from live to online education.

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Authors' contribution.

Dr.SunitJadhav along with Dr.Oshin and Dr.Suresh designed the study, wrote the protocol, helped in the statistical analysis and wrote the first draft of the manuscript. Dr.Suresh and Dr.T.Vijayasagar performed data analysis and revised the final draft of the manuscript. Dr.Sunit performed the experimental work. Aishwarya and Olivia managed the literature searches.

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Table 1. Examination Format

Sec.	Question Type		Moodle Feature Used	MPE			AIAE and BIAE		
				No. of Questions	Total Marks	Time allotted (in minutes)	No. of Questions	Total Marks	Time allotted (in minutes)
A	**MCQ Quiz**		Quiz	4	4	5	40	40	45
B	**Essay**	**Single Line (SL)**	Assignment	-	-	-	10	20	150
		Short Essay (SAQ)	Assignment	1	6	10	5	20	
		Long Essay (LAQ)	Assignment	-	-	-	2	20	
JPG to PDF Conversion				-	-	5	-	-	15
Total				5	10	20	57	100	210

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Figure 1: Distribution of Subject of Study Groups

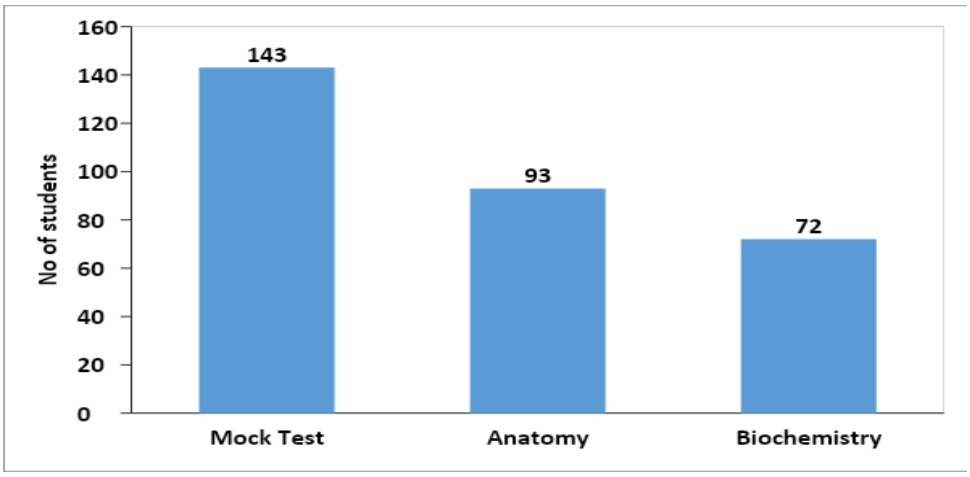

Figure 2: Degree of technical problems faced [Conversion of the picture into PDF] by Study Groups

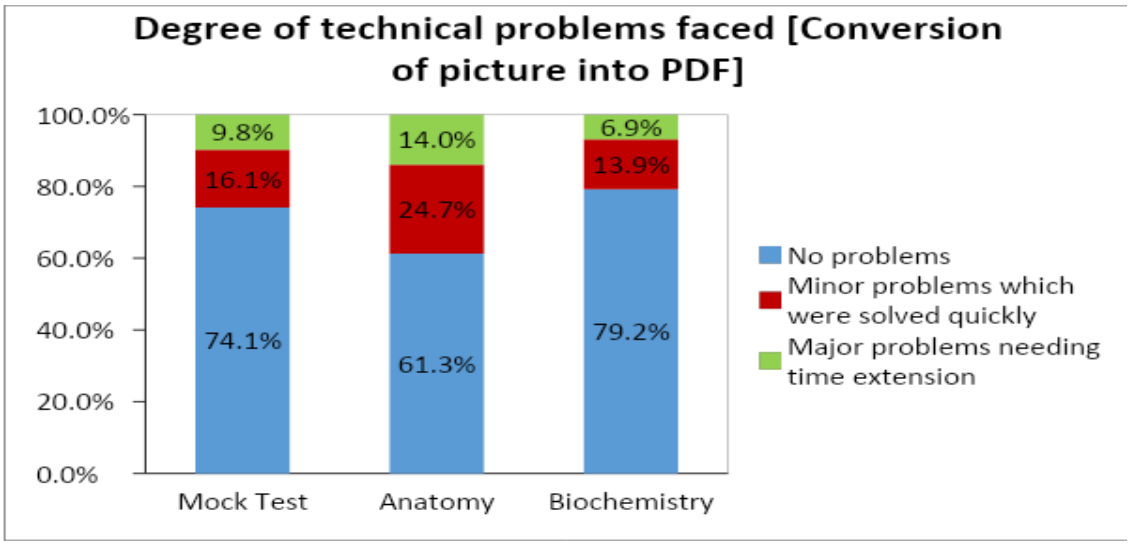

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Figure 3: Degree of technical problems faced [Uploading of PDF] by Study Groups

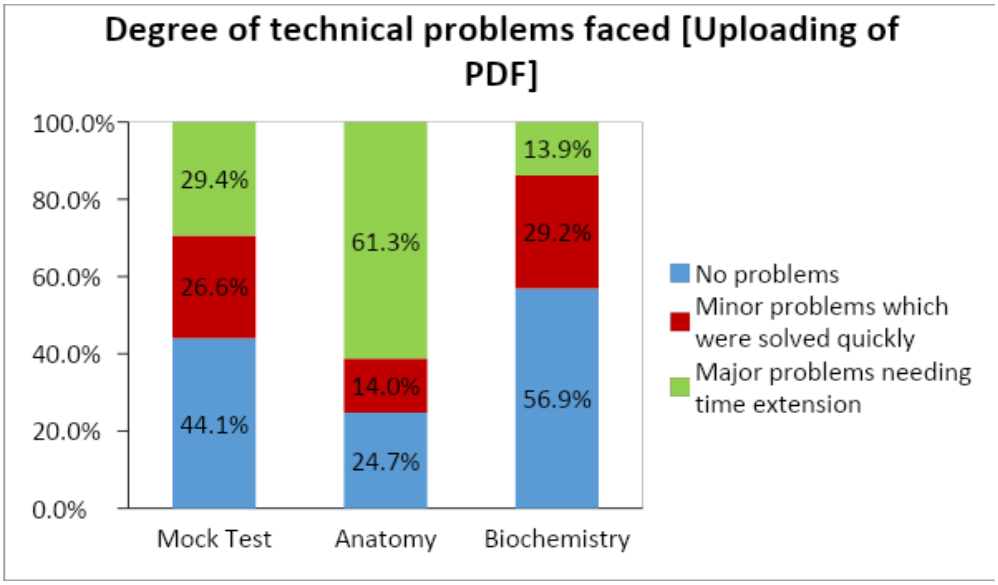
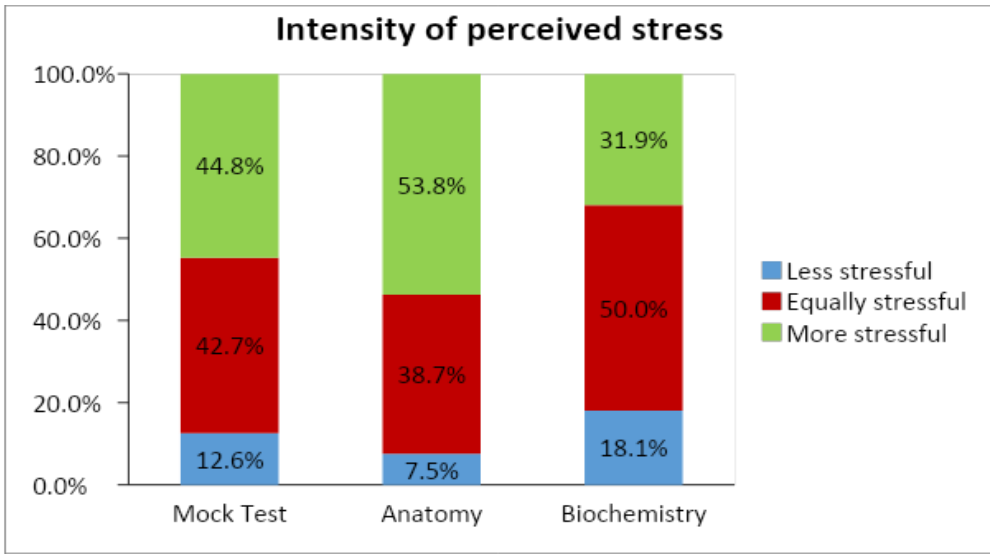


Figure 4: Intensity of perceived stress in comparison with an actual classroom examination setting by Study Groups



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