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Research Article

The New Order Of Web-Based Assessment System In Higher Education: A Study Of An Indian B-School

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ARTICLE INFO

ABSTRACT

We used a mixed method and experimented with the features of the web-based online system Moodle applied in four programmes offering business management courses with more than 400 students per trimester at Birla Institute of Management Technology (BIMTECH), Greater Noida, a premier Private B-School in India. The study assesses Moodle, e-Mail, and a self-developed Knowledge Management System based on Network Address Translation (NAT) platforms. The major contributions of this study are as follows: First, it adapts Moodle an online Learning Management System (LMS) platform for conducting web-based external examinations smoothly. Second, it compared the outcomes of three modes of external examinations, i.e. Offline, Online, and Hybrid and their relevance in the digital era. Third, it provides an option of a self-contained assessment tool for fair and better results. Thus, the innovative design saved the efforts of both teachers and students, demonstrating its future implications and effectiveness in higher education.

Keywords: Web-based assessment system, Moodle, NAT, self-contained test paper generation, India, higher education and Business Management.

1.Introduction

In this era of remote working several leading universities and education institutions are in search of an effective examination management system. Amidst high uncertainty because of the pandemic in March 2020, one of the leading private B-Schools in India, BIMTECH, faced the challenge of conducting online examinations in the aftermath of the spreading COVID virus in India. The advisory from the expert committee of the University Grants Commission (UGC)[1] was that if conducting online examinations was not feasible, the management of B-schools could complete assessments by doubling internal evaluation marks. While the safety net was offered to educational institutes, it was felt that this would be the easy way out and the examination/Information Technology (IT) department(s) were entrusted with the role of recommending a system that would retain the criticalities of teaching, learning, integrity, and proctoring in a single comprehensive system. As it was a unique situation that the educational system found itself in, a unique solution had to be found to address the teaching and learning challenges imposed by COVID. BIMTECH was required to prepare a system addressing the challenges imposed on the education system. This study was designed to formulate a new format of the online examination system to account for the various challenges aligned with such forms of examinations (Alghamdi, 2020; Guo, 2017; Zhang, 2015). The new format of online teaching, learning, and evaluation system for the various challenges are enumerated in this paper.

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2. Review of Literature

The new age of education requires innovative methods to evaluate student performance. The automatic assessment of descriptive answers in an online examination system brings challenges for remote access and evaluations of papers using semantic relational features (Nandini, 2020; Alghamdi, 2020). These semantic relational features require the use of Artificial Intelligence (AI) based learning methods and integration of face recognition in online examination systems to prevent any form of false representations in examinations (Patil, 2019). Another perspective of research on this subject has been to innovate the system design and implementation of online examination systems based on intelligent test paper composition (Peng, 2018). In this study, a new method of self-contained Question Paper (QP) design evolved as the new order for remote examinations. Albeit this requires a higher order learning orientation at the teacher's/paper-setter's/examiner's end. Thus, this elicits the need for a well-designed examination system that integrates all these features and assesses students' achievement of program learning objectives. Ultimately in internet-based examinations, it's the effectiveness of technology that is important for the smooth processing of online examination systems (Ko & Cheng, 2004; Stensaker, et. al., 2008).

The other perspective was to explore, design, and implement an online examination system for grading objectivity in essay-type questions for capturing higher-order learning outcomes like analytical and reflective thinking which got manifested and displayed through effective writings (Adewumi, 2016). The current study articulated a method to assess both analytical and reflective thinking as well as the writing skills of the examinees.

Further, any online examination system relies on the composite design of an assessment system with a higher-order learning focus (Askarali, 2015). The integrated module developed in this paper has incorporated the composite design of the examination system that envisioned high-quality assessments and learning outcomes. In this era of automation, another crucial aspect of aspiring institutions has been the design and development of an efficient online examination system using the Internet of Things which has become the new order of technology (Babu, 2018). The new order had brought a novel idea for remote examinations which was a natural outcome of online teaching that COVID thrust on institutions worldwide. This inspired authors as protagonists to design and implement an academic online examination system to cater to new requirements. The new order of systematic design and application of a web-based online examination system with a well-designed feedback system brings forth a technology-driven remote examination system (Taşci, 2013; Blair, 2014; Jiang, 2020). This further facilitated the design of the web-based online examination system to meet the requirements of the criticalities of the current situation as presented in this paper.

3. Method

The study is descriptive and follows a blended approach based on process innovation used to develop an integrated process of LMS to conduct online examinations with process reengineering. It uses the process reengineering to transform the existing features to an advanced level, which is with the novel method of resource management. Moodle and Google platforms were used in this study to conduct online examinations with limited resources like limited internet connection, with mobile phones etc . Paired sample t-test (SPSS 25)was used to analyze pre-online (offline mode) and online mode performance scores of students, which are discussed in the following section.

4. Development and Implementation of Online Examination System Architecture

Birla Institute of Management Technology set an ambitious goal of conducting online examinations on the Moodle platform. Moodle released the 3.8 version with advanced tracking features which was installed in the middle of June 2020, just in time for Term 3 examinations scheduled from 25 June 2020. Subsequently, the IT/examinations department conducted a mock test for students. Two videos were prepared and circulated the first for faculty to develop and upload QP and the second for students to download QPs and upload answer sheets at the end of the test after scanning. Students were expected to write answers themselves on A4 size plain paper to ensure that Unfair Means (UFM) were not used in examinations. It was decided that there would be an innovative design of proctoring by tracking student movements in Moodle which was later equipped with visual proctoring through Google Meet/Zoom. This enabled effective monitoring by faculty/managers who later in consultation with the IT/examination department assessed student claims related to technological inadequacies like network failures, power failures, system crashes, etc.

The team of experts from the Examinations and IT Departments developed an innovative method of examinations that encapsulated the following features:

(i) The selection from the existing LMS modules.

(ii) Modifications were made in the LMS by upgrading the feature of assignment submission to incorporate the current examination system requirements.

(iii) Institutes' indigenous Network Application Technology (NAT) was used to share information with students. It was further customized to meet the requirements of a backup system for downloading examination QPs if any problem was encountered in doing so from Moodle.

(iv) All answers were written using pen and on A4 size sheets in the candidate's handwriting to avoid copying from the internet.
(v) Answer sheets were sequentially numbered, scanned, and uploaded to the concerned faculty's Moodle folder by the cutoff time in one continuous scan.
(vi) A competition between the various programs of Management, i.e. Business Management, International Business, Insurance Business Management, and Retail Management was set up to enhance and motivate the programs for prompt submissions in Moodle.
(vii) Late submissions were tracked in Moodle to ascertain if the excuses for late submission were genuine or otherwise. Students were advised in advance that only submissions in Moodle would be considered.
(viii) For Term 3 examinations, the internal assessment to end-term examination evaluation ratio was kept at 70:30 to stress continuous internal assessment and minimize end-term examination stress on students.
(ix) For Term 4 examinations, the ratio was kept at 70:30, and submission time was reduced to 30 minutes from 45 minutes that was allowed in Term 3 examinations.
(x) Analytical questions were used in examinations which removed the need for intensive proctoring.

4.1 Online Learning Management System Architecture

The architecture of the online LMS concerning the flow of activities and responsibilities is presented in Figure 1. The LMS administrative rights were managed by the IT department. The examination department facilitated the system with the necessary inputs and subsequent monitoring. Another feature for the network database management system known as the NAT platforms was also used for accessing QPs in case of any LMS default. For conducting web-based external examinations smoothly, the LMS Module and its assignment feature were used as an examination management module. IT was designed to meet all the challenges faced by the respective stakeholders.

Insert Fig 1: The overall architecture of the proposed online examination system.

The examination management module contained two sections first, the teacher management module, and second on the student management module.

4.2.1 Teacher management module

The teachers were trained to use Moodle's feature on assignments, for QP upload/answer sheet download from the Assignment Section (a process based on a demo video developed for teachers/faculty members).

4.2.2 Student management module

The students were trained on the process of QP download/answer sheet upload in the Assignment Section (a process based on a demo video for students).

4.3 Learning Management System Featured Activities

The assignment feature of LMS (Moodle based) was used for conducting examinations in the online mode (Exhibits 1A, 1B, and 2).

Insert Exhibit 1A: Moodle feature on assignment under add an activity for uploading question paper

Insert Exhibit 1B: Moodle features on question paper upload under assignment with details

Insert Exhibit 1C: Moodle feature on answer sheet submission details

4.3.1 Examination management module

As detailed earlier, Moodle, e-mails, and a self-developed Knowledge Management System based on NAT platforms were used as an alternate for any failure caused by Moodle malfunctioning.

4.3.1.1 Test Paper Generation

Faculty were required to access their Moodle account and upload QPs on the assignment section of the respective course's Moodle folder (Figure 2).

Insert Fig 2: The process of self-contained test paper generation in online system

The answer sheet was downloaded from the assignment section of the respective course under the concerned faculty's Moodle account for evaluation.

4.4 Success Coordinates of Online Examinations

Overall the re-engineered LMS used as the online examination platform served the purpose. The success parameters were assessed term-wise in terms of online submissions and their smooth conduct. The details are shown in Table 1.

Insert Table 1: Details of Exam Papers and Program-wise Moodle submission

5. Findings and Analysis

This section explains the important findings of this study . The study primarily is divided into three parts first is Y1 i.e 2018-2020 batch, which refers to fully offline mode of examination. Second is Y2 i.e 2019-2021 batch, which refers to hybrid mode (Partially offline/online mode). of examination. Third is Y3 i.e 2020-2022 batch, which refers to fully online mode of examination. The findings based on paired samples t-test revealed interesting outcomes based on student assessment results with respect to the three different modes ie Offline/Hybrid and Online.

Y1-Y2 : Offline Vs Hybrid mode

A paired-samples t-test was conducted to compare the performance of students in full offline conditions (offline mode-Y1) and partial offline/online (hybrid) Y2 conditions, as shown in Table 2A, 2B, and 2C. There was no significant difference in the mean scores/grades obtained in offline mode ($M = 7.170$, $SD = 0.612$) and during partial online/offline (hybrid mode) ($M = 7.298$, $SD = 0.541$) conditions; $t(236) = -2.2968$, $p = 0.023$. These results suggest that the partial online/offline (hybrid) mode of examination has a significant effect on the final grades of students and therefore this mode of examination can be avoided as an alternate option to address the challenges of pandemics (COVID-19). In case of choice, either fully offline or fully online mode should be preferred rather than hybrid mode.

Insert Table 2A: Paired Samples Statistics (Y1-Y2)

Insert Table 2B: Paired Samples Correlations (Y1-Y2)

Insert Table 2C: Paired Samples Test (Y1-Y2)

Y2-Y3 : Hybrid vs Online mode

A paired-samples t-test was conducted to compare the performance of students in partial offline/online Y2 and full online conditions (online mode-Y3) conditions, as shown in Table 3A, 3B, and 3C. There was no significant difference in the scores/grades for pre-online ($M = 7.298$, $SD = 0.541$) and fully online ($M = 7.251$, $SD = 0.478$) conditions; $t(236) = 0.968$, $p = 0.334$. These results suggest that the online mode of examinations does not have any significant effect on the final grades of students and therefore online examinations can be an alternate option to address the challenges of pandemics (COVID-19). Care should however be taken to ensure the standard format of the QP. The study suggests having test papers with self-contained features which will be suitable for assessing analytical and reflective understanding of students.

Insert Table 3A: Paired Samples Statistics (Y2-Y3)

Insert Table 3B: Paired Samples Correlations (Y2-Y3)

Insert Table 3C: Paired Samples Test (Y2-Y3)

A paired-samples t-test was conducted to compare the performance of students in offline mode, namely, Y1 and fully online conditions (online mode-Y3), as shown in Table 4A, 4B, and 4C. There was no significant difference in the scores/grades for offline (M = 7.170, SD = 0.773) and fully online (M = 7.251, SD = 0.478) conditions; t(237) = −1.137, p = 0.103. These results suggest that the online mode of examinations does not have any significant effect on the final grades of students and therefore online examinations can be an alternate option to address the challenges of pandemics (COVID-19).

Insert Table 4A: Paired Samples Statistics (Y1-Y3)

Insert Table 4B: Paired Samples Correlations (Y1-Y3)

Insert Table 4C: Paired Samples Test (Y1-Y3)

The study finally evaluates all three formats of examinations, i.e. Y1 (offline mode), Y2 (partial offline/online: hybrid mode), and Y3 (fully online mode). Based on the analysis, a fully offline mode is most preferred and in case of any exigency like that of COVID-19, a fully online mode is suggested. The results further suggest that a hybrid mode of examinations is not advisable in the interest of students learning outcomes and quality assessment.

6. Conclusion

The online examinations at BIMTECH in 2020-21 brought a lot of challenges and learnings for future reference.

6.1 Journey of BIMTECH

The saying goes *difficult roads lead to beautiful destinations*, so it was in mid-March 2020 when the spread of the virus had become fast and was causing unrelenting growth in COVID infections. All B-schools were seized with the problem of how online end-term examinations should be conducted with students stuck in their homes in a country-wide lockdown. Bewildered with uncertainties, people accepted the challenge and decided to articulate a *new age examination system*.

6.2 Opportunity Exploration

Several vendors demonstrated their platforms for online examinations with proctoring solutions which claimed to keep students from using UFM during examinations. It was felt that these proctoring solutions would not only stress students due to the "fish bowl" syndrome of being watched and monitored during examinations but were far from the objective of preventing UFM.

The UGC Expert Committee's report 2020 on online examinations mentioned a non-mandatory alternate to complete pending end-term assessments by using internal marks as the variable state of net connectivity pan-India could disrupt online examinations. UGC, however, left it to the respective institutions to decide their strategies as long as they did not unduly further stress students in difficult times.

6.3 Paradigm Shift with Management's Support

Given the high cost/imperfect solutions offered by vendors who based their commercial offers on per student per subject basis, BIMTECH internally decided not to take the easy way out of doubling internal marks but to go on with a case study based on online end-term examination using Moodle. The blended format for Term 3 assessment used an internal end-term weightage of 70:30. This decision was taken as students were already conversant with Moodle and it was preferred to use the software rather than experiment with a new third-party platform (which would entail training and getting used to for all concerned). A meeting with class representatives of students and the management of BIMTECH was convened in which the concerns of students were noted and addressed, viz., lack of preparedness, not having study material, difficulties encountered during the preparation period, etc.

Given the views of stakeholders, it was decided to have an abridged version of the end-term examination using a self-contained case study in each subject to check students' analytical reasoning and assess their achievement of Course Intended Learning Objectives (CILOs). The case study would be administered in 1.5 hours as against the full end-term examination of 2.5 hours. There would be no proctoring but students were expected to answer the questions posed in the case study on their own without any external help in their handwriting using pen and paper (on plain A4 sheets). The answer sheets would be numbered and scanned by the student after the examination along with his/her BIMTECH photo identity card. Students were given another 30 minutes to do the scanning and uploading of their answer sheets on the Moodle account of the concerned faculty. As the

faculty's Moodle was pre-programmed to show the QP on the appointed date/start time of the examination and was open for uploading of answers within 2 hours from the start time, it became a time-bound exercise.

6.4 The Monitoring and Mid-course Corrections

On day one as only two-thirds of the students were able to upload answers in Moodle balance sending answer sheets by email, it was decided to extend the Moodle window by 15 minutes. This led to an immediate notable improvement in answers uploaded which were more than 90% on day 2. An innovation introduced was good daily communication with the management and students about the progress of examinations. Healthy competition was set up by naming the daily best program in terms of uploading answer sheets in Moodle. The students were also equipped with an alternative route to circumvent latency delays in Moodle by allowing the download of QP using BIMTECH's NAT folder and answer sheet submissions using Moodle. This, in turn, added convenience as well as promoted meticulous submissions within the allotted time.

This was coupled with good coordination between the examinations department and the IT help desk in using the tracking of students during the examination using the inbuilt tracking facility in Moodle 3.8. Any excuses offered by students for not being able to connect to Moodle due to network problems could be refuted by cross-checking the student's tracking records during the examination. The students were also made aware that their movements in Moodle were being tracked and they could not fool the authorities with lame excuses. This revamping strategy became a game changer and ensured 100% submissions with around 95% through the Moodle platform.

6.5 The New Horizon

The online Term 3 examinations were concluded on July 3, 2020. There was an all-around appreciation by all stakeholders and no complaints were received from faculty/students. Online Relative Grading (RG) was completed within the stipulated time frame without any error.

6.6 Learnings

Based on the findings the study deduced that subjective expression writing is important for the examination pattern at higher management levels. Therefore, the students seeking higher degrees through the online education system had better be evaluated through both objectives as well as subjective modes of examination. It acknowledges that certain subjects may not require subjective expression testing. However, it concludes that the online examination system must employ subjective expression testing for all subjects to which it remains applicable. Based on findings from the literature the study further concludes that the effectiveness of technology is important for the smooth processing of online examination systems (Ko & Cheng, 2004; Stensaker, et. al., 2008).

As the wary of learning changes, more and more people acquire the knowledge they need through the internet. Examination systems have gradually transformed from means based on traditional printed paper to online ones. This paper proposes a new web-based online examination system, which utilizes Moodle, e-mails, and a self-developed Knowledge Management System based on NAT platforms. The online examination system covers self-contained tools (QP), and internal log details (for proctoring), including testing well-monitored collection, user management, online testing, real-time score calculation, answer checking, and results analysis. This system was applied to more than 400 students per trimester for a 2-year business school program.

The study compared all the three formats of examinations, i.e. Y1 (offline mode), Y2 (partial offline/online: hybrid mode), and Y3 (fully online mode). It suggested a fully offline mode as the most preferred mode of examination even in any exigency like that of COVID-19. The results further suggested that a hybrid mode of examinations is not advisable in the interest of students learning outcomes and quality assessment. Also, the merit of self-contained test papers has been found to give promising results.

7. Practical Implications

The paper shows that older and newer forms of quality assurance are becoming more integrated with the potential of creating quality assurance procedures addressing teaching and learning issues more directly. The modern-day web-based examination system is undergoing a paradigm shift in this era of digitization and remote working. The new age academia has been experimenting with several LMS modules, to attain higher-level learning outcomes. In this endeavor, institutions are in the quest for an effective and well-articulated assessment method for online examinations. Online examination is being used in education and other fields due to its advantages of efficiency, safety, convenience, and fairness.

8. Limitations of this System

Though the system has implemented most of the major functions and modules for the completion of an online examination system, it still has some limitations such as a fool proof proctoring system and an automated paper

generation system. More efforts will be made to improve its capability to adapt to the different needs of online examinations in the future.

9. Future Areas of Focus

There is a need to focus on the following:
(i) Use of analytical questions and typed answers
(ii) Integration of Anti-plagiarism Tools (APT) in the platform to check answers online
(iii) Using caselets with uniform difficulty levels to be picked at random from a pool
(iv) Caselets where difficulty level can be increased with correct answers and vice-versa.
(v) Percentile system of award of grades (as in GMAT/TOEFL examinations) to remove manual RG.

10. Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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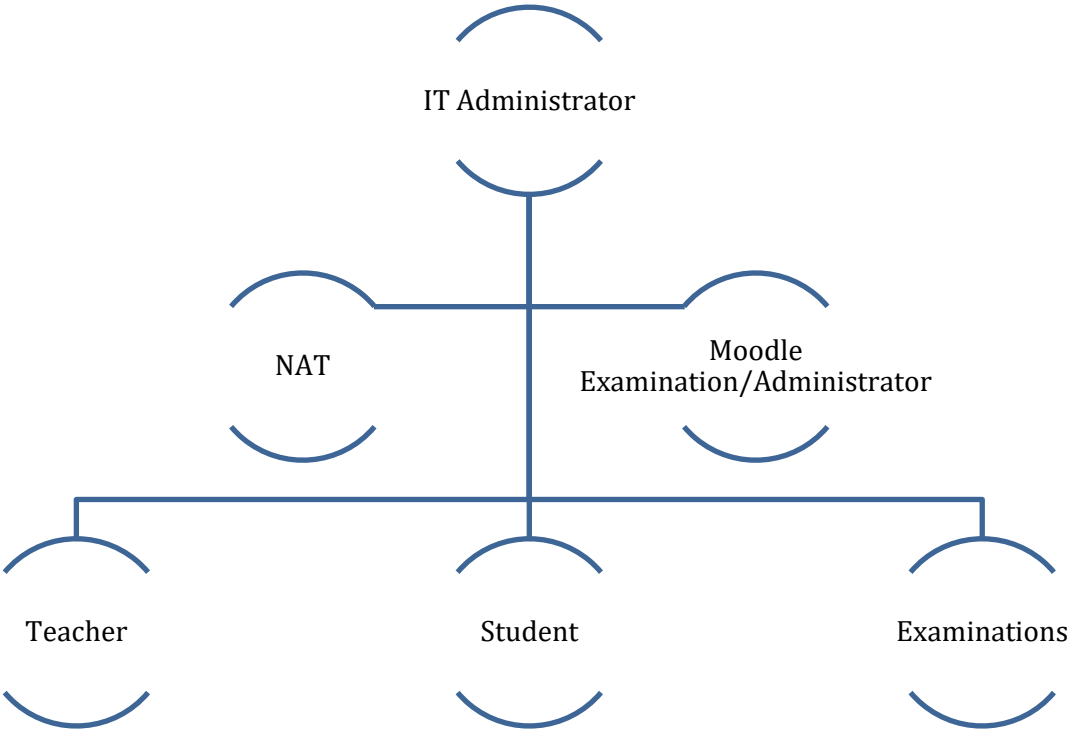
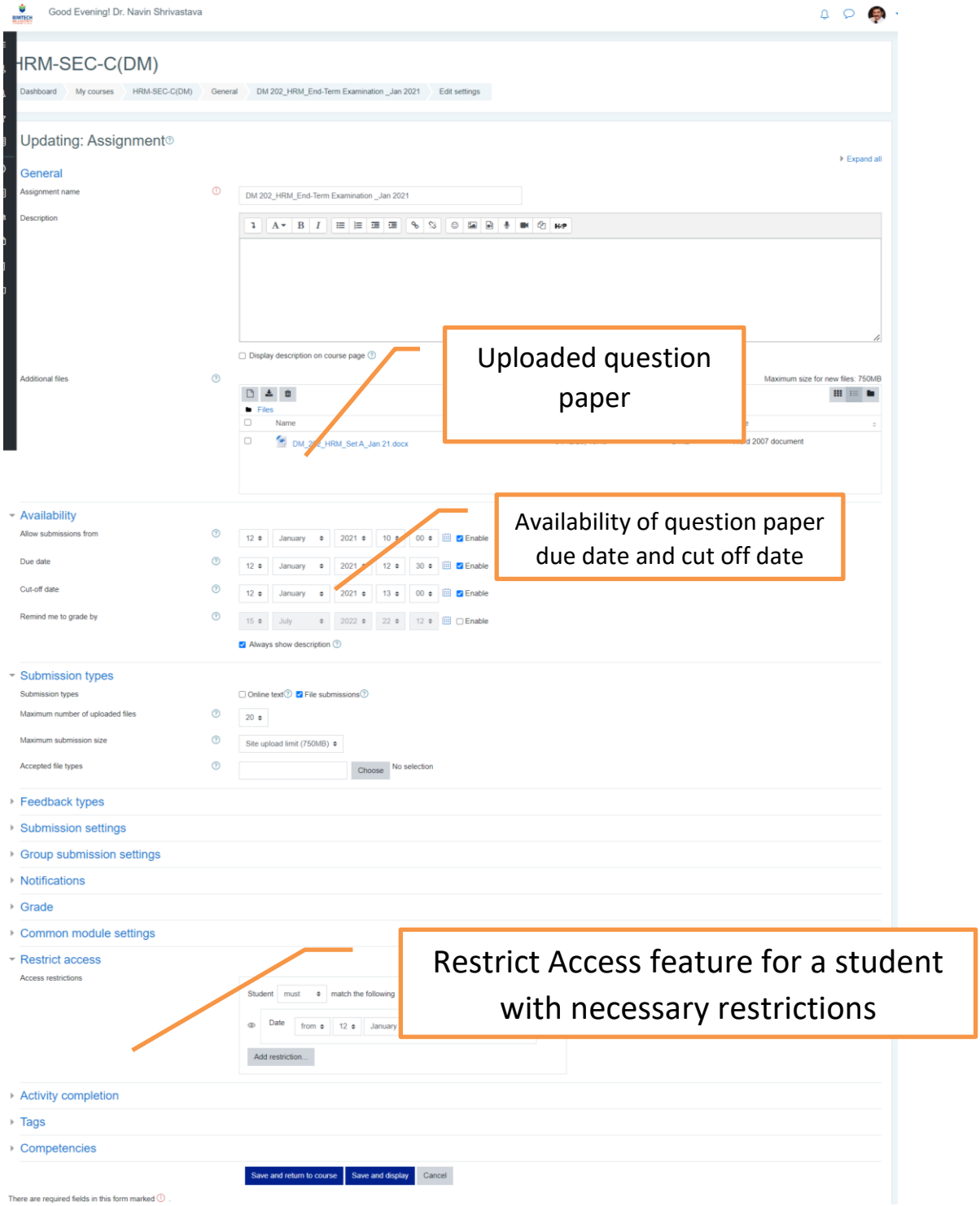


Figure 1: The overall architecture of the proposed online examination system
Source: Compiled by researcher

Exhibit 1A: Moodle feature on assignment under add an activity for uploading question paper

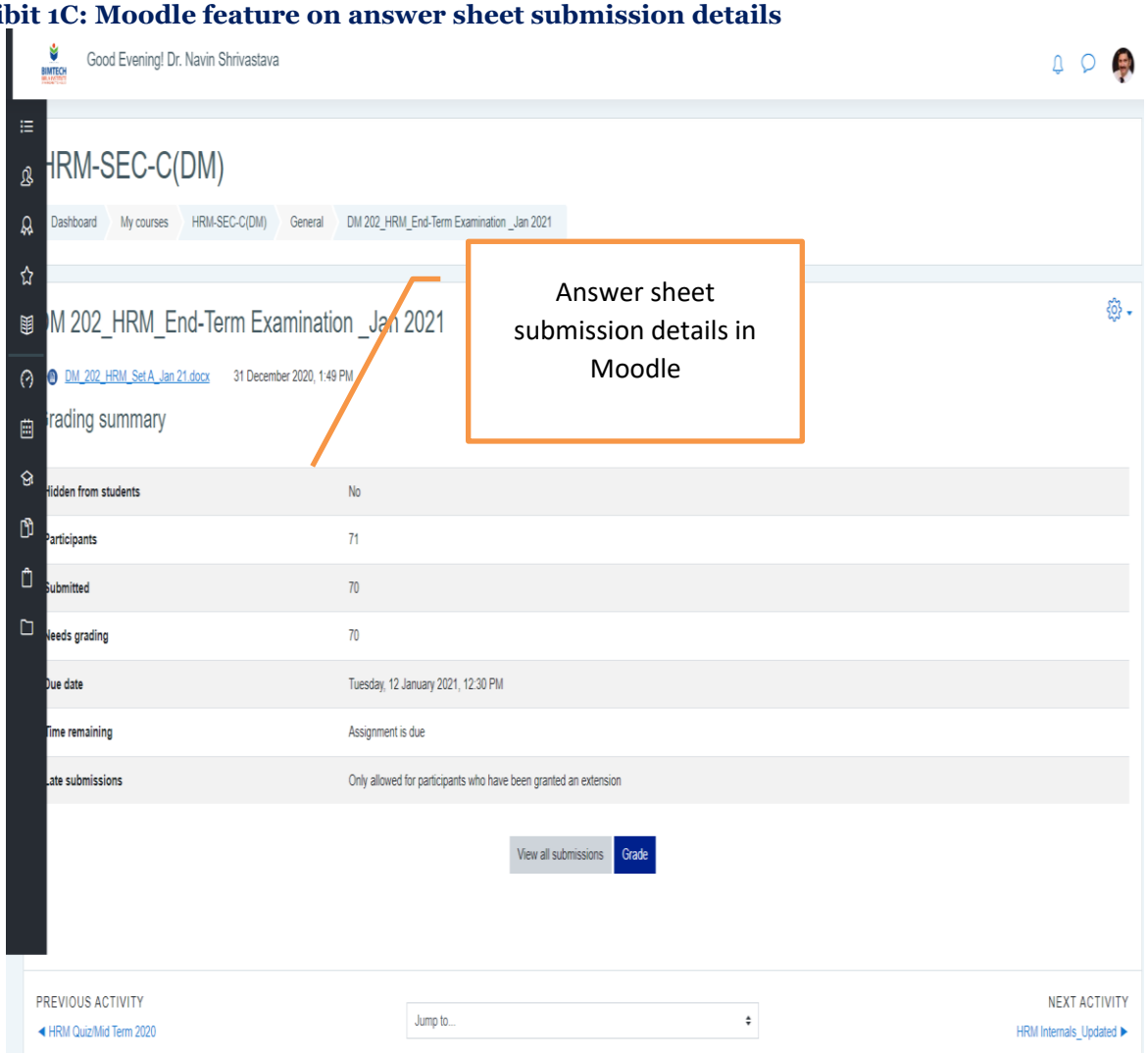
Source: Extracted from Moodle 3.8

Exhibit 1B: Moodle features on question paper to upload under assignment function with details



Source: Extracted from Moodle 3.8

Exhibit 1C: Moodle feature on answer sheet submission details



Source: Extracted from Moodle 3.8

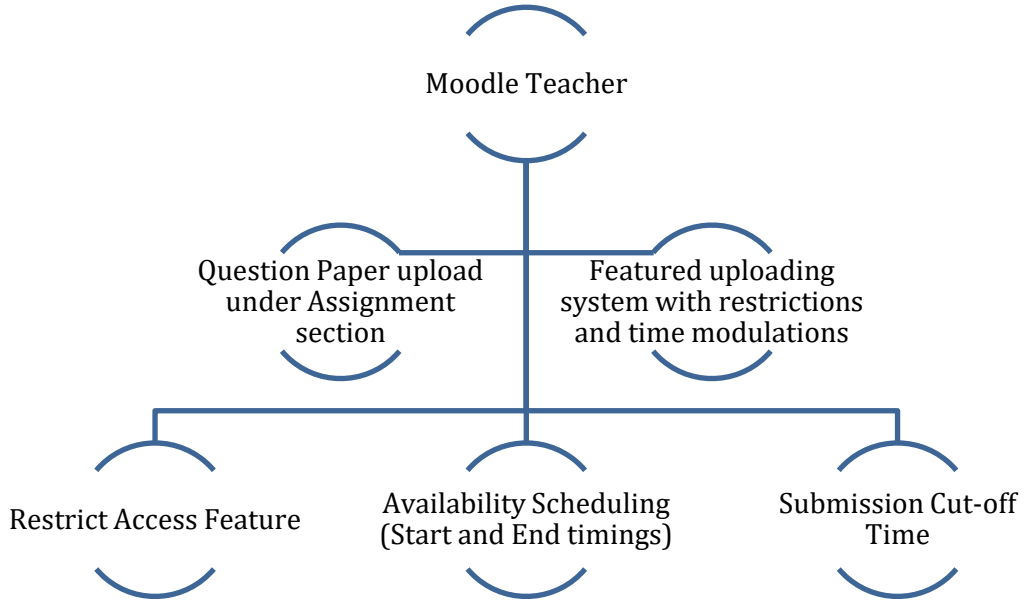


Figure 2: The process of self-contained test paper generation in online system
Source: Compiled by researcher

Table 1: Details of Examination Papers and Program-wise Moodle submission

Term Nos.		Term III (2020-22)		Term IV (2020-2022)		Term I (2021-2023)		Term V (2020-2022)		Term II (2021-2023)		Term VI (2020-2022)	
S. Nos.	Programs	June-July 2020 (In %)	Total Papers	September 2020 (In %)	Total Papers	October 2020 (In %)	Total Papers	December 2020 (In %)	Total Papers	January 2021 (In %)	Total Papers	February 2021 (In %)	Total Papers
1.	PGDM	95	16	92.27	22	84.47	8	95.58	15	95.69	7	_	_
2.	PGDM (IB)	92.74	13	95.05	19	92.62	8	98.38	14	98.54	8	81.82	1
3.	PGDM (IBM)	92.5	5	95.38	8	94.18	7	100	1	99.21	7	97.5	2
4.	PGDM (RM)	98.89	5	96.42	8	94.01	8	98.87	6	99.2	8	96.61	3
5.	Aggregate	94.78	39	94.78	57	91.32	31	98.21	36	98.16	30	91.98	6

Source: Compiled by researcher

Table 2A: Paired Samples Statistics (Y1-Y2)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Y1	7.170	237	0.612	0.039
	Y2	7.298	237	0.541	0.035

Table 2B: Paired Samples Correlations (Y1-Y2)

		N	Correlation	Sig.
Pair 1	Y1 and Y2	237	−0.049	0.453

Table 2C: Paired Samples Test (Y1-Y2)

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Y1 - Y2	−0.1248	0.837	0.054	−0.231	−0.017	−2.296	236	0.023

Notes: Y1: Batch 2018-20 (*offline mode*), Y3: 2019-21 (*partial offline/online mode*)

Table 3A: Paired Samples Statistics (Y2-Y3)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Y2	7.298	237	0.541	0.035
	Y3	7.251	237	0.478	0.031

Table 3B: Paired Samples Correlations (Y2-Y3)

		N	Correlation	Sig.
Pair 1	Y2 and Y3	237	−0.048	0.459

Table 3C: Paired Samples Test (Y2-Y3)

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Y2 – Y3	.046	.739	.048	-.048	.141	.968	236	.334

Notes: Y2: Batch 2019-21 (*partial online/offline mode*), Y3: 2020-22 (*full online mode*)

Table 4A: Paired Samples Statistics (Y1-Y3)					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Y1	7.170	238	0.6128	0.0397
	Y3	7.251	238	0.4780	0.0309

Table 4B: Paired Samples Correlations (Y1-Y3)				
		N	Correlation	Sig.
Pair 1	Y1 and Y3	238	0.011	0.866

Table 4C: Paired Samples Test (Y1-Y3)									
		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Y1 - Y3	−0.082	0.773	0.050	−0.180	0.016	−1.637	237	0.103

Notes: Y1: Batch 2018-20 (*offline mode*), Y3: 2020-22 (*full online mode*)