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Learning Analytics Model and Bloom's Taxonomy based Evaluation Framework for the Post Graduate Students' Project Assessment – A Blended Project Based Learning Management System with Rubric Referenced Predictors

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Abstract
Effective engagement and monitoring of students' online self-learning capacity and application of their acquired knowledge in the final year project is a challenging task for the educators worldwide. The author builds an evaluation framework to assess the stage-wise performance of students in this undertaken project. The primary objective of this research study is to classify the rubric reference predictors of the stage wise project performance assessment metrics for the learning analytics based decision support system and effective academic decision making. The students of the post graduate computer applications degree programme, supervisors, external industry guide, internal faculty members of the peer review committee, external examiner and Head of the Department are the major stake holders of the proposed evaluation framework. The proposed framework computes the students' individual as well as class attainment level of learning outcomes in their final year capstone projects. The author adopts blended Learning approach based on the principles of Blooms' taxonomy using Google classroom as the LMS. The correlation matrices of the assessment predictors, mapping with course outcome and blooms' levels are also obtained. The students' attainment level of course outcomes are assessed using effective cognitive sequencing of the assessment methods and the respective rubric referenced predictors with the stage-wise feedback system.

Keywords: Evaluation Framework, Rubric Referenced Predictors of the Assessment Methods, Project Based Cyber Earning

Introduction

Knight et al (2020) have designed their learning analytics model and addressed the five key challenges viz, a focus on impact on learning through augmentation of existing practice, the centrality of tasks in implementing learning analytics for impact on learning, the commensurate centrality of learning in evaluating learning analytics, inclusion of co-design approaches in implementing learning analytics across sites and an attention to both social and technical infrastructure. They further emphasized that learning analytics approach has the potential to impact student learning depending on scale and academic eco system. Yigit et al. (2014) have successfully deployed the teaching and learning processes using blended learning approach for the subject "Algorithm and Programming" course of a computer engineering undergraduate programme. The further defined that Blended Learning is a learning model that is enriched with traditional learning method and online education materials. Integrating online and face-to-face learning, Blended learning is achieved through Learning Management System (LMS) of university by using distance education technology. LMS comprises of course materials, student records, user roles, evaluation system such as surveys and quizzes that meet SCORM standards (Yigit et al., 2014)

The author of this case study being a project coordinator, have tried with the blended learning approach for this undertaken project since the students were working in their respective onsite project companies as project trainees. As the project category would vary for each student, it was very apparent that periodic assessment would be a difficult task for the internal faculty guides. Hence the periodically revised curriculum with updated course outcomes as the performance indicators were considered as the assessment metrics for the design of the framework The revised course outcome statements are updated based on blooms level as shown in Tab-1.

Table 1: Course Outcomes

- CO1-Define the real time problem/ research project scopes, objectives and deliverables with project schedule.
- CO2-Design with a system modeling language tool and draw diagrams, covering all modules of the project.
- CO3-Write effective programs to develop user interface design, database design, processing logic and generate reports.
- CO4-Apply various software testing tools for the test cases and implement the project modules with a consolidated project report.
- CO5-Demonstrate the working project to the end user with system and user manual.

The motivation behind this work and the process metrics of the corresponding macro level goals and micro level objectives are discussed in the following sub sections. The related works of this project and literature survey is done in the section 2. In section 3, the author explains the conceptual learning analytics model and the process metrics and objectives of the assessment framework design of the proposed system. Section 4 describes the data capturing Instruments & Cognitive sequencing of the Assessment methods and discusses the student attainment level with descriptive analytics and correlation matrices. Section 5 concludes the article with future research direction.

Motivation & Macro level Goals

Quality enhancement of the academic delivery system in an Indian higher education institution is the motivation behind this research case study. The following are the macro level goals.

- Implementing and internalization of quality sustenance and quality assurance processes.
- Effective online and traditional engagement of the students in their respective project companies.
- Integrating the students' previous semesters acquired knowledge in their capstone project.
- Implementation of the automation procedures and online project management system with the industry standard learning management system tool.
- Institutional level accreditation by the approved authorities like NAAC- India and other International recognition.

Problem Definition

Martin et al. (2019) have done an explorative study and extensively discussed their strategies and framework and concluded that course rubrics created on the outcome achievement report identifies how each student learning outcome correlates with the learning outcomes of the program. Hence, the design and development of suitable learning analytics model and evaluation framework for the post graduate final year students 'capstone project performances is the undertaken project. The requirement analysis and the respective data capturing is done with a blended learning management system tool for the stage wise assessment for class strength of 51 post graduate computer applications students 'final year project performance The primary objective of the system is the design of the data capturing instruments with the classification of rubric referenced predictors for the respective assessment methods based on the principles of the bloom's taxonomy. The proposed learning analytics model comprises of carefully prepared data capturing instruments for the proposed learning analytics model. This decision support system computes the student wise attainment level of the final year capstone project course learning outcome against the targeted threshold value and generates various descriptive analytics reports.

Micro Level Objectives

After the careful formulation of macro level goals, the author derived the respective micro level

objectives and presents here as follows.

- Problem statement with major keywords of the study.
- Literature survey on related works and preparation of review summary.
- Identifying the research gaps.
- Detailed Problem description with appropriate title
- Dynamic updating of course outcomes with respect to Blooms taxonomy.
- Adopt blended approach to monitor the student's online as well a traditional engagement by the faculty members.
- Reviewing the project milestones as per project schedule.
- Identify the appropriate industry standard Learning Management System tool.
- Classifying student wise project categories and project confirmation letter from the authorized source.
- Select the appropriate assessment methods for the project reviews.
- Performance indicators or criteria and the respective rubric referenced predictors.
- Cognitive sequencing of the assessment methods as per the principles of Bloom s taxonomy.
- Build an evaluation framework for the assessment of performance indicators with the Learning Management System LMS
- Assessment of reinforcement learning of design and programming concepts using Project Based Learning pedagogy.
- Assessment of testing and implementation procedure of the capstone project.
- Compute the student wise, class wise, programmewise attainment level of the learning outcomes of the respective courses
- Find the correlation index between the course outcomes and assessment methods
- Evaluate the course outcomes statements as per the principles of blooms taxonomy quantitatively for the final year project course.
- Find the student wise and class wise course outcome attainment level against the targeted threshold.
- Project report assessment with writing rubrics metrics.

Hence the objectives of this case study are very well defined by the author now. After the formulation of above mentioned micro level objectives of the proposed system, the detailed literature survey of the related works on the topics of the research case study was done and summarized in the next section.

Literature Survey

Mateo et al., (2012) have presented the fundamental characteristics of the Final Year Project (FYP) in this research work. They further classify them into associated competences and some evaluation standards that derived from a research conducted by the region government of Catalonia (Spain) and the Catalan University Quality Assurance Agency. Ma and Ma (2009) have suggested a three-level hierarchical linear model (HLM) was presented as a general analytical framework to separate program effects while taking into account the hierarchy in educational data, for handling the multiple education projects. Hickey and Zuiker (2012) have used an alternative framework that uses emerging assessment perspectives to align learning across increasingly formal levels of educational practice. They further pointed out the importance of general and specific assessment design principles for aligning instruction, assessment, and testing and for evaluating instructional innovations (Hickey & Zuiker, 2012).

Altanis and Retalis (2019) have proposed a a multifaceted assessment framework of the degree of students' acquisition of multiple skills,which explored the highly positive learning experiences and promoting their thinking skills, e.g., programming and computational thinking (CT) skills (Altanis & Retalis, 2019).They implemented a system with computer science undergraduate students, which are presented, highlight the positive effects of combining and extending various assessment techniques and tools to draw holistic conclusions about students' higher skills including computational and spatial thinking skills (Altanis & Retalis, 2019). Vijayalakshmi et al. (2013) have emphasized the importance of outcome based education and adopted OBE in their work and framed the course learning objectives for the final year under graduate project course work. They further stated that outcome of

each phase of the project muse assessed and mapped with programme outcome (Vijayalakshmi et al., 2013). They defined capstone projectas a tool to encourage students to apply the knowledge acquired during their studies in the previous semesters and solve real time applications or research based computational problems. The assessment is done based on the rubrics written for each phase of the process(Vijayalakshmi et al., 2013). The outcome of the each phase is assessed by evaluation team and the guide using the assessment matrix which is based on assessment rubrics (Vijayalakshmi et al., 2013). Damaj and Yousafzai (2016) have proposed a unified framework for the assessment of student outcomes which comprises of criteria, indicators, extensive analytic rubrics, and a summative statistical formulation Fatima K. Abu Salem et al, (2020). Damaj and Yousafzai (2016) have argued in their study that a capstone project is a culminating experience that entails creativity, critical thinking, and advanced problem-solving skills.

Petkov et al. (2008) have derived the criteria from related works they reviewed as follows Technical level of proficiency demonstrated through application of the technical knowledge associated with the course. is otherwise called as craftsmanship, Problem solving skills and ability to organize information, ability to compare a problem situation against best business practices or to select and justify the best alternative solution is otherwise known as methods in related works survey (Petkov et al., 2008). Organizational, interpersonal and time management skills demonstrated in the execution of the project is referred as project management skills (Petkov et al., 2008), Communication skills, demonstrated through the organization of the project and its presentation is derived from other works as Sophistication of performance (Petkov et al., 2008).

Learning Analytics Model and Evaluation Framework's Experimental Design Set up for Blended Learning Management System

Alomari et al. (2020) have concluded in their evaluation framework study that despite the widespread availability and increasing use of cyberlearning environments, there remains a need for more research about their usefulness in undergraduate education, particularly in STEM education. The process of evaluating the usefulness of a cyber learning environment is an essential measure of its success and is useful in assisting the design process and ensuring user satisfaction (Alomari et al., 2020).

Kumar and Bervel (2019) indicated that Google Classroom was more beneficial compared to other LMS as it is accessible as a free mobile app, easy to use, reliable and provides a platform for network community with a slight resemblance to Facebook user interface. Technology has been rapidly changing and evolving how we teach in the classroom. Students today are known as millennial and digital natives that seem to assimilate technology in every mundane aspect of their lives (Kumar & Bervel, 2019). They further stated that, they are actually digital immigrants with different levels of technological literacy (Kumar & Bervel, 2019). Learning Management System (LMS) software which is said to be the most widely used educational technology tool in higher education (Kumar & Bervel, 2019). Examples of LMS are Moodle, Blackboard, Edmodo, Schoology, Sakai and Google Classroom etc. From the mentioned list of LMS tools, Google Classroom has recently been advancing in popularity, importance and most rapidly adopted tool in higher education (Kumar & Bervel, 2019). Zarraonandia et al (2019) argued in their study that the use of augmented reality (AR) to support the learning process has been extensively researched but its use to support the teaching practice has just started to be explored (Zarraonandia et al., 2019). They further pointed out that a communication system that makes use of a pair of Google Glass to provide the teacher with a constant and private flow of information on the students' current knowledge. The proposed system allows the information sent by the students through their mobiles to overlap with the teachers' live vision of the class (Zarraonandia et al., 2019). Thus the approach and selection of research tool i.e Google class room for the assessment framework implementation for the students 'capstone project performance is justified for this case study.

Thus here in our work, conceptual framework is designed for stage wise data capturing using Google class room learning management system tool. The primary objective of the system is to embed the principles of blooms taxonomy with the extensive

rubrics for the various assessment methods and compute the post graduate computer applications students' attainment level of the final year project course learning outcome against the targeted threshold value. The architecture design comprises of.

Preliminary Project Management Process Metrics for the Evaluation Framework-Phase- I

- The identification of all the stake holders and the mapping the respective roles and responsibilities have been well articulated in the course curriculum policy document of the post graduate degree course of Master of Computer applications.
- The approval procedure of the various project categories and documentation requirement includes collecting industry project confirmation letter from the industry for the official approval by the head of the department and marking scheme for the formative assessment as well as summative assessment.
- The assessment criteria and performance indicators are selected as the explanatory predictors of the proposed system based on the principles of blooms taxonomy.
- The project proposal document, project guidelines and project admin policy document, faculty internal guides and their respective specialization.

Evaluation Framework Design Metrics Phase – II

- Reframing the course outcomes for the capstone project depending on the registration if needed.
- Revised project guidelines for the blended approach assessment.
- Fixing weight age to the performance indicators with a marking scheme for both formative assessment and summative assessment as per the project guidelines.
- Extensive analytics rubrics and marking scheme for all formative assessment methods.
- Correlation Matrix Of Course Outcomes With Assessment Methods
- Correlation Matrix Of Blooms Level With Assessment Predictors
- Student's Attainment Of Course Outcomes
- Preliminary review – Criteria & Rubric
- First review, second & third review – Criteria & Rubric
- Demonstration & project report review – Criteria & Rubrics

Assessment Metrics for the Students Project Requirement Analysis

- Describe the Systems Development Life Cycle (SDLC).
- Evaluate systems requirements.
- Complete a Problem definition.
- Evaluate a problem definition.
- Determine how to collect information to determine requirements.

Perform and evaluate feasibility studies like cost-benefit analysis, technical feasibility, time feasibility and Operational feasibility for the project

Assessment Metrics for Project Category & Software and Hard Ware Requirements

- Project Category
- Decide the S/W requirement specifications and H/W requirement specifications.
- Preparation of Software requirement Specification
- Project Description with Modules as per Design

Assessment Metrics for the Students' Project's System Design

- Work on data collection methods for fact finding.
- Construct and evaluate data flow diagrams.
- Construct and evaluate data dictionaries.
- Evaluate methods of process description to include structured English, decision tables and decision trees.
- Evaluate alternative tools for the analysis process.
- Create and evaluate such alternative graphical tools as systems flow charts and state transition diagrams.

Detailed Students Project Description and System Design Phase

- Plan the systems design phase of the SDLC.
- Distinguish between logical and physical design requirements.
- Design and evaluate system outputs.
- Design and evaluate systems inputs.

- Design and evaluate validity checks for input data.
- Design and evaluate user interfaces for input.
- Design and evaluate file structures to include the use of indexes.
- Estimate storage requirements.
- Explain the various file update processes based on the standard file operations.
- Decide various data structures.
- Decide the various processing systems to include distributed, client/server, web based or Mobile application development.
- Construct and evaluate entity-relationship (ER) diagrams for RDBMS related projects / web based frameworks.
- Construct Database Design with primary keys and foreign keys and
- Perform normalization in tables created for RDBMS related projects
- Perform project cost estimates using various techniques. Schedule projects using both GANTT and PERT charts.

Assessment Metrics for Software Coding Phase

- Perform module wise coding as per Software requirement Specification.
- Integrate all the modules with the common main program.
- Perform various systems testing techniques/ strategies to include the phases of testing.

Software Testing Phase

- Writing test cases for the finished product.
- Systems implementation and its key problems.

Report Generation

- Generate various reports.
- Be able to prepare and evaluate a final report.

Software Maintenance

- Brief the maintenance procedures and the role of configuration management in operations.
- To decide the future scope and further enhancement of the system.

Project Report

- Appendices to be placed in support with the project report documentation.
- Prepare user manual and System manual and give end user training
- Work effectively as an individual or as a team member to produce correct, efficient, well organized and documented programs in a reasonable time.

Data Capturing Instruments & Cognitive Sequencing of the Assessment Methods

A class of 51 MCA, post graduate students of the computer applications programme, project coordinating faculty members, faculty members of peer review committee members, internal faculty guide, external industry guide and external examiners for the final viva voce examination are the stakeholders of the proposed system..The preliminary project phase captures the basic data for all the above mentioned stake holders.

The registration process with the selected learning management system tool i.e. Google class room gets completed during stipulated time. The respective faculty guide effectively engages the project trainee students allotted to him and update the assessment records.

Hamandi et al., (2020) have successfully designed a assessment framework and conclude in their work that the framework comprises of criteria, indicators, extensive analytic rubrics, and an aggregate statistical formulation. They further state that a capstone project is a culminating experience that entails creativity, critical thinking, and advanced problem-solving skills. To that end, capstone projects enable students to prove their abilities, demonstrate their attained skills, and carry out a significant project. The authors designed the general flow of the system flowchart as shown in figure 1 entitles as evaluation frame work.

Ullah et al. (2019) have presented in their study which presents a novel approach to assessing students' competency in programming using Bloom's taxonomy. The novelty of the presented approach is based on some rules that quantify the attained competencies with respect to the cognitive levels of Bloom's taxonomy (Ullah et al., 2019). The x level of blooms taxonomy are as given below

Table 3: Course Outcomes Mapping with Bloom's Level

• CO1-Define the real time problem/ research project scopes, objectives and deliverables with project schedule. BL-1
• CO2-Design with any system modeling language tool and draw diagrams, covering all modules of the project. BL-2
• CO3-Write effective programs to develop user interface design, database design, processing logic and generate reports. BL-3,4
• CO4-Apply various software testing tools for the test cases and implement the project modules with a consolidated project report. BL-4,5
• CO5-Demonstrate the working project to the end user with system and user manual. BL-6

BL-Bloom's Taxonomy Levels: 1-Remembering, 2-Understanding, 3-Applying, 4-Analyzing, 5- Evaluating, 6-Creating

Mutalib et al. (2012) have argued in their study that In order to improve the courses offered, the measurement and evaluation process. Suitable assessment method needs to be chosen, depending on the expected course outcome and the delivery method (Mutalib et al., 2012). They further emphasized that Rechecking the presently available curriculum , Rechecking the stucture and content of courses, Innovative teaching method, Innovative measurement and assessment method,and Data and evidence collecting system

Interim Project report – Assessment Metrics

- Title of the project
- Problem Definition and existing manual system.
- Requirement analysis with use case text
- Draw
  - Use case diagram
  - Activity Diagram
  - Class Diagram
  - Sequence Diagram with appropriate design tools.
- Project Category (Client server application, networking/Multimedia/Artificial Intelligence/ Expert Systems etc.)
- Literature survey on the proposed systems, current technologies, application and related works on theory background.
- Design with various DFD levels, ER diagram and architecture diagram for the proposed system.
- Software and Hardware selection with justification.
- Solution methodology and Project Planning and Scheduling (Gantt chart and PERT chart)
- Database creation with master Tables and Transaction Table and data
  - Structure, with Primary and Foreign keys, and proper constraints in the fields (as per project requirements)
- Project description with Module Confirmation Visualize the Input screens, while creating the modules the modules are framed as per the data flow diagram. These flow diagrams depict the flow of the process and development process. This flow will be carried out throughout the development process.
- SRS –Software Requirement Specification for the proposed system coding with module Description for Client Server application / Web and Mobile projects
  - Welcome Display and Input Screens for user login and admin login exclusively with validation checks.
  - Main Menu for application projects
  - Data base creation with appropriate data structure as per class diagram design with validation checks.
  - Updation Programs for Master Tables and Transaction Tables with validation checks.
  - Data Entry programs Module by adding, deleting and modifying records / Data preprocessing.
  - Reports Generation programs with processing Logic / Training and Testing with classifier and clustering algorithms.
  - Testing and Implementation / Comparative performance analysis with evaluation metrics and results interpretation.
- Project Demonstration with knowledge of execution procedure.
- Project Delivery with report preparation and provide end-user training with user manual and systems manual.

Design of Instruments for Assessment Methods and Discussion on the Intelligence Reports Generated

Table 1: Correlation Matrix of Course Outcomes with Assessment Methods

Course Code:		**Name : Project**		**Class : MCA VI Sem**			**Batch -2018-2020**		
		Formative Assessment					**Summative Assessment**		
Course Learning Outcomes	Project Initiation Process & Problem Definition	Project Proposal Approval by Project review committee as per Project category	Review -1 Literature Survey and Design with Diagrams with Module wise project description	Review - 2 Software / Research tool Selection & Coding with minimal reports report generation	Review - 3 Interim Project report Submission & Demo	Final Project Report - Project Guide's Internal Evaluation	Peer Review Committee & Project Coordinators Evaluation	Total Internal (50 %)	Project Viva (50%) External examination
Marks	15 Marks		20 Marks	20 Marks	20 Marks	10 Marks	15 Marks		
CO-1	3	3	-	-	-	3	3		3
CO-2			3	-	3	3	3		3
CO-3	-	-	-	3	2	3	3		3
CO-4	-	-	2	1	3	3	3		3
CO-5			3	2	3	3		3	
Note: Justification for high, medium and low correlation 3, 2 & 1									

Table 2: Correlation Matrix of Blooms Level with Assessment Predictors

Course Code:	**Name : Project**		**Class : MCA VI Sem**			**Batch -2018-2020**		
	Formative Assessment					**Summative Assessment**		
Course Learning Outcomes	Project Initiation Process & Problem Definition	Project Proposal Approval by Project review committee as per Project category	Review -1 Literature Survey and Design with Diagrams with Module wise project description	Review - 2 Software / Research tool Selection & Coding with minimal reports report generation	Review - 3 Testing & Implementation. Interim Project report Submission & Demo	Final Project Report - Project Guide's Internal Evaluation	Peer Review Committee & Project Coordinators Evaluation	Total Internal (50 %)	Project Viva (50%) External examination
Criteria	**Assessment Predictors**								
	I		II	III	IV	V	V		
BL1	3		1	-	-				
BL2	2		2	2	-				
BL3	1		3	3	2	1	1		

BL4	-	3	3	3	1	1		
BL5	-	-		3	3	3		
BL-6	3	3	2	2	3	3		
BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 –Analyzing, 5 –Evaluating, 6 - Creating)								
Note: Justification for high, medium and low correlation 3, 2 & 1								

Table 3: Student's Attainment of Course Outcomes

								Date :	
Course Code:		**Class : MCA VI Sem**			**Student's Name :**			**Batch -2018-2020**	
Assessment Methods	Project Initiation Process & Problem Definition	Project Proposal Approval by Project review committee as per Project category	Review -1 Literature Survey and Design with Diagrams with Module wise project description	Review - 2 Software / Research tool Selection & Coding with minimal reports generation	Review - 3 Interim Project report Submission & Demo	Final Project Report - Project Guide's Internal Evaluation	Peer Review Committee & Project Coordinators Evaluation	Total Internal (50 %)	Project Viva (50%) External examination
Max Marks	15 Marks CO-1		20 Marks CO-2	20 Marks CO-3	20 Marks CO-4	10 marks CO-5	15 marks CO-5		
Secured Marks	14		18	18	18	9	14	46	45
Threshold %	65		65	65	65	65	65		
Attainment %	94		90	90	90	90	93		
						Total(Internal + External)			91%
CO wise student attainment % = (Secured marks / Max marks) * 100 Over all course learning outcome is: 91%									
Project Guide			**Project Coordinators**			**HOD-CA**			

Table 4: Preliminary Review – Criteria & Rubrics

Innovation	**Review of Literature** (Concept / Technology)	**Review summary with Gap Analysis**	**Marks** Range (0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Problem Definition & Suitable project Title with keywords	**Project Category** (Real-time Industry Application / Research)	**Domain / Industry Vertical** Clarity	**Marks** Range (0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Presentation	**Content Quality**	**Coherence & Language**	**Marks** Range (0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	

Table 5: First Review – Criteria & Rubrics

Data Description	**Data Source** Excellent/V.G/Good/Average/Nil	**Related works survey comparison** Excellent/V.G/Good/Average/Nil	**Marks** Range (0-5)
Design with Module Description	**Use case/Class/Sequence/ Architecture/ER Diagrams/DFD**	**Module wise Project description**	**Marks** Range (0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Justification for the selection of System software	**Citation and references**	**Official web pointers**	**Marks** Range (0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Presentation	**Content Quality**	**Coherence & Language**	**Marks** Range (0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	

Table 6: Second Review – Criteria & Rubrics

Module wise coding & Linking Process	**Sample code**	**Screen shots a per DFD**	**Marks** (Range 0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Code Base & Implementation	**Readability &Security**	**Interoperability & usability**	**Marks** (Range 0-10)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Demo & Presentation	**Content Quality**	**Coherence & Language**	**Marks** Range (0-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	

Table 7: Third Review – Criteria & Rubrics

Interim Project Report	**Project Abstract & Milestones achieved as per Project Schedule with log sheet**	**Project report format & Chapter Plan**	**Marks** Range (1-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Testing & Implementation Procedures	**Functional Test cases with Requirements Traceability matrix**	**Non Functional Test cases**	**Marks** Range (0-10)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	
Demo & Presentation with visual aids	**Content Quality**	**Coherence & Language**	**Marks** Range (1-5)
	Excellent/V.G/Good/Average/Nil	Excellent/V.G/Good/Average/Nil	

Table 8: Final Project Report - Criteria & Rubrics

		Marks
Logical structure and clarity of writing	No logical structure/Poorly structured/ Satisfactory structure / Well structured and well written / Clear and logical presentation	Range (1-5)
Understanding and analysis	No understanding of project aims and results / Patchy understanding of project aims and results / Satisfactory understanding of project aims/ Good grasp of project aims/ Excellent analysis, evidence of original contribution to or development in field	Range (1-5)
Results	No results, did not meet basic project aims / achieved some of basic project aims/ Satisfactory results / Commendable results/ Excellent results	Range (1-5)
Production standard	No attempt to present report in consistent and intelligible format/frequent errors in formatting compromising meaning and readability/ Satisfactory results/Good standars/ Excellent	Range (1-5)
Scientific conventions	No coherent referencing, error estimation and use of technical terms / incomplete referencing, error estimation and use of technical terms, frequent mistakes / Satisfactory referencing, error estimation and use of technical terms, minor mistakes / Good use of referencing, error estimation and use of technical terms, occasional mistakes/ Excellent referencing, error estimation and use of technical terms, few, if any, mistakes	Range (1-5)

Table 9: Supervisors' Evaluation Criteria & Rubrics

		Marks
Comprehension level of project objectives	no understanding /patchy understanding /satisfactory/good/excelent	Range (1-10)
Effort	no effort /Patchy, inconsistent effort – bare minimum achieved / Satisfactory effort at recommended level to achieve adequate results/Commendable and consistent effort above level expected to achieve adequate results/Student showed exceptional dedication to project	Range (1-10)
Experimental / modeling competency	no practical competency/ Able to conduct simple practical tasks with assistance/ Able to conduct simple practical tasks without assistance, tackled complex tasks with help / Able to complete complex practical tasks competently with some assistance / additional guidance / Able to complete complex practical tasks efficiently after instruction, with minimal guidance	Range (1-10)
Record keeping	No record keeping /Erratic and undated /Regular but incoherent in places, dated / Coherent but lacks detail, dated / Clear, detailed and dated	Range (1-5)
Intellectual Input	No input ,/ ideas, occasional input /Constructive ideas, satisfactory input / Significant contribution, sustained input, some original thought / Leading contribution sustained over project duration, independent and original thought	Range (1-5)
Extent of supervision / student initiative	Continuous supervision, little or no student initiative /Frequent supervision, patchy student initiative / Regular supervision, satisfactory student initiative/ Infrequent supervision, significant and sustained student initiative /Modest supervision, student assumed initiative	Range (1-10)

Communication skills – ideas, concepts and discussion	Student barely able to communicate basic ideas / concepts, little or no input into discussion /Understandable but occasionally unclear communication, contributed to discussion with prompting / Intelligible and generally clear communication, unprompted contribution to discussion /Coherent communication, significant contribution to discussion / Articulate and confident communication, student able to lead discussion	Range (1-10)
Organization and planning	No organization / planning / Patchy organization / planning, unable to prioritize tasks - supervisor set detailed task list / Satisfactory organization, student able to prioritize tasks with help/Well organized, student able to prioritize tasks unaided / Excellent organization and planning, student set and prioritized short and long term goals	Range (1-10)

Conclusion

Learning analytics model and evaluation framework for the post graduate students' capstone project assessment has been designed and deployed in the Google class room. Bloom's taxonomy based rubric referenced predictors of blended project based cyber learning management system have been tested in the project reviews organized by the project coordinators as per the project schedule. The experimental design of the learning analytics model accomplished successfully the various tasks assigned to all the stakeholders of the cyber learning management system. The stage wise feedback system helped the faculty members to immediately address the problem and take remedial measures. Student wise attainment of the learning outcomes is obtained and the predictors mapping with respect to the various assessment criteria and learning outcomes show the low, medium and high level correlation. This learning analytics model demonstrates only descriptive analytics based decision support system pertaining to the class strength of 51 students. However, it can be scaled up for the entire programme covering all the subjects and in turn further scaled up to satisfy and the needs of the department, school and university level operations with cloud deployment provide predictive analytics based decision support system.

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