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ACCOMPLISHMENT OF COURSE LEARNING OUTCOMES: A RELATIVE STUDY OF APPROACHES AFFECTING CLOS VS ASSESSMENT MAPPING

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ABSTRACT

This study explores whether types of assessments and number of assessments given per semester influence the fashion of achieving CLOs score or not. Considering here CLO score primarily a key that determines quality of a course taught at bachelor's level, quality which is emancipated at the time of compiling the final results. The association in student outcome and adequacy of CLO score, determined while analyzing results for the course CSM 216 are incredibly interesting. Overall, in the study spanned around two sections of students, CSM-216-325, and CSM-216-326, quite obvious relevance in assessments versus CLO's is observed. Two more concerns arise consequently, first is the variety of assessments, and second is the timings of assessments that are affecting CLO's score prominently, as measured by the evolutionary matrix. There were no significant variances found in CLO score while operating on three measuring scales including distribution on examinations only, distribution on 80% of assessments, distribution on 100% of assessments. Prime differences are obtained only when including all the weekly assessments, counted the planned & surprised quiz along with scheduled exams, and weightage for abrupt responses.

KEYWORDS: CLO stands for Course Learning Outcomes, assessment distribution, CLOs Score, Mapping CLOs, SO is for students' outcomes

1. INTRODUCTION

University systems focus on the quality of academic understanding apart from skills, that is why while designing a course, course learning outcomes and course objectives are defined categorically. Attaining sufficient results as per designed course objectives and course learning outcomes fully aligned with program learning outcomes is something emphasized to achieve by the quality department.

This study is about the features that effect quality of the course taught in the university in a broader perspective. But precisely in is focusing on the effects of assessments on quality of the course taught. Now the question arises: how the quality is determined for a specific course. So here this study refers to the quality matrix designed by the quality department by following NCAAA guidelines. This paper is covering few features of the quality matrix instead of focusing on the overall document. Author is

intended to start with the assessments and see the effect of assessments on the overall performance of the students that in turn leads to the score obtained in the CLO's as per quality matrix. In general a common perception is that lesser the assessments given in a semester, better the results would be achieved by the students. Secondly, the time duration assigned to accomplish an assessment is found critical to overall achieve better CLO score. In hard core computer sciences subjects as the subject under study "Data structures and Algorithms" project-based assignments, case studies, assessment the one handling understanding of architectural complexities, are all computation based and need high intellect along with mathematical and logical abilities of the students. Such amalgam is perfectly relevant with the program learning outcomes. These core courses being taught at degree level principally impact the success of student in the practical field later on. For that matter, It is learnt through literature study that Persistence in teaching methodologies and assessment plan may lead to a stable but useless level that graduates may pass the course with good marks but would not be able to develop better understanding of implementation level details. While scheming the CSM-115 and CSM-216(Data Structures & Algorithms-1 & 11) assessments, respectively, over the course of time, it was analyzed that mode of assessments right away shape up the pattern of student's outcome in general. Moreover, the effects of three assessment distribution strategies on student outcomes are analyzed in this study by using simplest statistical methods. Keeping in mind that assessment is a strategy to improve student learning in which three key questions should be asked and addressed at the course-level:

A. What do you want students to know, be able to do, and what perspectives should they acquire, as a result of studying this particular course?

B. How do you know students achieved the intended/expected student outcomes for learning?

C. How do you use the collected evidence to improve student learning/outcomes in an ongoing continuous improvement cycle?

Here are the CLO's kept in view for the quality studies.

CLO-1.0: Designate the basics functionality of a data structure as an abstract data type.

CLO-2.1: Design solutions and solve problems computationally through the application of fundamental data structures and algorithms.

CLO-2.2: Compare and evaluate the complexity of algorithms for linear and nonlinear Data Structures.

2. RESEARCH QUESTIONS

The following questions provided the direction for this study:

RQ1: Does the type of assessments; lecture-based, project-based, and peer-led assessments effects attaining CLO score as measured by the author in CSM-216?

RQ2: Was there a significant difference in CLO scoring depending on the type of assessments?

RQ3: Was there a significant difference among the CLOs scoring; when all the assessments were mapped compared to the mapping based on three major examinations, including midterm, Final practical and final theory examination.

RQ4: project-based, and peer-led assessments included by instructor based on challenging course content, follows which fashions of CLO mapping.

3. METHODOLOGY

This study examined whether long range of assessments while teaching subjects like Data Structures & Algorithms-2- CSM 216, have an effect on attaining optimal CLO's score, to what extent effective

mapping influences the CLO score, what distribution of assessment percentages lead to better CLO's scoring? And which factors remain persistence in pursuing an above average CLO's score? The variables were measured and analyzed using the simple statistical analyzing methods. This current study included three groups; fully distributed (100%) mapping, 80% Distribution, and Examination-based assessment. This research is being conducted on the results or final score of the subject CSM-216, students qualified in December 2020.

There were two sections of students, Sec#325 and Sec#326 where this course was offered, which is infect a continuation of the auxiliary course taught previously CSM-115.

Group three consisted of a class in BIOL 1306 and another class in CHEM 1311 that was taught in peer- led instruction. The variables were the names and types of assessments; Examination based include three kinds of exams, Mid, Final theoretical and Final Practical. Advanced level assignments and quizzes that are based on real time problem solving. Group of Students whose data is sampled here is affiliated with College of Science and Arts, Sarat Abeda (all females). The dependent variables included CLO's. The CLO's that are subjected to study include CLO 1.0, 2.1 and 2.4. The control variable included the assessments given during lectures which were supposed to be fully surprised assessments. Both the sections of students were assessed distinctly. The significant differences in each of the CLO mappings on the variable of distribution percentage was measured by author. Moreover, apart from CLO's score, the other areas of interest included factors that determine relevance of course assessments with quality of course taught. The successful completion of the course included high range of CLO's score, instructor's diversity of course content, instructor's formation of course assessments, and instructor's persistence of carrying on the course on uniform pace.

Population and Sample

The sample is collected from Sarat Abeda College, primarily, it is about students enrolled in computer sciences department. Sampling was purposive because the subjects were selected based on students enrolled in the computer science courses "Data Structures & Algorithms-2- CSM-216". This is an advancement of an introductory course taught as CSM 115. Previous studies indicated that poor distribution of assessments and the lack of student engagement was a big reason for not achieving the desired goals. Therefore, two sections of CSM-216 were identified as samples.

CLO TO SO MAPPING

Here the course learning outcomes are mapped with students' outcomes in tabular form, results are calculated in percentage. Five CLO based on the category of skills and knowledge are catered.

Course Learning Outcome		CLO Domain	Assessments								
			Theory							Lab	
			Assignment-1 (Numerical)	Assignment-2 (Case Study)	Quiz 1	Quiz 2	Mid Exam	Final Quiz	Final Exam	Lab Exercises	Lab Exam
1.1	Describe the basics and functionality of a data structure as an abstract data type.	Knowledge	30%				40%		30%		
2.1	Design solutions and solve problems computationally through the application of fundamental data structures and algorithms.	Skill		30%			30%			40%	
2.2	Compare and evaluate the complexity of algorithms for linear and non linear Data Structures.	Skill			10%			40%	50%		
2.3	Apply appropriate data structure for varied application and system softwares.	Skill				20%	30%		50%		
2.4	Articulate and present innovative ideas for solving varied computing problems using hybrid data structures with low complexities.	Skill		40%					30%	30%	

Table 3.1- CLO TO SO MAPPING (DISTRIBUTION BASED ON 10-40% OF ASSESSMENTS & 60% Examination)

Table 3.1 depicts student's outcome pattern in case the assessments given were 10 % of the total course assessment portion. The pattern obviously predicts that more the percentage allotted to the assessments, more distribution it incorporates and as per percentage of the assessments, diversity of CLOs attained. In case, the assessments are few, the diversity of the course is minimized which leads to attaining fewer CLOs compared to the case where gradually distributing assessments percentage to assignments and quiz leads to attaining more diversified CLOs specially those posing to enhance skills set.

Course Learning Outcome		CLO Domain	Assessments								
			Theory							Lab	
			Assignment 1	Assignment 2	Quiz 1	Quiz 2	Mid Exam	Final Quiz	Final Exam	Lab Exercises	Lab Exam
1.1	Describe the basics and functionality of a data structure as an abstract data type.	Knowledge					100%				
2.1	Design solutions and solve problems computationally through the application of fundamental data structures and algorithms.	Skill					50%		50%		
2.2	Compare and evaluate the complexity of algorithms for linear and non linear Data Structures.	Skill							80%		20%
2.3	Apply appropriate data structure for varied application and system	Skill					10%		70%		20%
2.4	Articulate and present innovative ideas for solving varied computing problems using hybrid data structures with low complexities.	Skill							100%		

Table 3.2- CLO TO SO MAPPING (DISTRIBUTION BASED ON 0% OF ASSESSMENTS & 100% of Examination)

Table 3.2 depicts the scenario where no assessments are given, all the CLOs are attained through examination system only. Such evaluation process leads to the results that are not much focused on CLO parameters, rather than predict overall general capabilities of the students in academia rather than depicting specified behaviors concerning each of the CLO category.

Course Learning Outcome		CLO Domain	Assessments								
			Theory							Lab	
			Assignment 1	Assignment 2	Quiz 1	Quiz 2	Mid Exam	Final Quiz	Final Exam	Lab Exercises	Lab Exam
1.1	Describe the basics and functionality of a data structure as an abstract data type.	Knowledge	10%		10%		20%		30%	10%	10%
2.1	Design solutions and solve problems computationally through the application of fundamental data structures and algorithms.	Skill		30%			30%			40%	
2.2	Compare and evaluate the complexity of algorithms for linear and non linear Data Structures.	Skill			10%			40%	50%		
2.3	Apply appropriate data structure for varied application and system softwares.	Skill		10%	10%	20%	10%	10%	20%	10%	10%
2.4	Articulate and present innovative ideas for solving varied computing problems using hybrid data structures with low complexities.	Skill	20%	20%		10%	10%		20%	10%	10%

Table 3.3- CLO TO SO MAPPING (DISTRIBUTION BASED ON 100% OF ASSESSMENTS)

Table 3.3 is fully mapped across all the CLOs. This is the scenario that is recommended here in this research for future adoption as the best case. This particular situation where all the students are

evaluated throughout the semester for their skill set and knowledge, it offers to cater diver CLOs and achieve them with minute details. Almost all the assessments here are backing the CLO set, which is highly recommended pattern.

4. ANALYSIS & RESULTS

This section comprises of the readings attained for a specific CLO based on the criteria of assessment distribution. This analysis incorporates readings for two course learning outcomes, first is CLO 1.1 and secondly CLO 2.1 and CLO 2.4 are analyzed for 100% of the assessments based on assignments, quiz and case studies.

CLO 1.1

Weight	10%	10%	10%	10%	20%	0%	20%	10%	10%	**CLO 1.1**
Score	4.26	4.72	4.72	4.81	4.56	0	4	4.61	4.84	
	0.426	0.472	0.472	0.481	0.912	0	0.8	0.461	0.484	4.51

Table 4.1-CLO 1.1 For Assessment based on 80% of assignments, quiz and case studies

The analysis is done on the excel sheets designed with the name "quality matrix". The resultant reading for CLO 1.1 is 4.51, which is obtained when course 216-CSM was evaluated on the bases of assessments as major or almost 80% part of the total evaluation. The depicted reading 4.51 out of a total 5 suggests that CLO 1.1 is attained quite well by distributing the assessments this way.

	Course Learning Outcome	CLO Domain	Assessments									Score	
			Theory							Lab			
			Assignment 1	Assignment 2	Quiz 1	Quiz 2	Mid Exam	Final Quiz	Final Exam	Lab Exercises	Lab Exam		
1.1	Describe the basics and functionality of a data structure as an abstract data type.	Knowledge					30%		50%		20%	4.15	100%

Table 4.2-CLO 1.1 For Assessments Based on Examination System

The resultant reading for CLO 1.1 is 4.15, which is obtained when course 216-CSM was evaluated on the bases of Midterm exam, Lab exam and Final theory exam, where the total exam percentage is 100% part of the total evaluation. The depicted reading 4.15 out of a total 5 suggests that CLO 1.1 is attained well but not better than what it is by distributing the total weightage up to 80% of assessments.

Weight	10%	10%	10%	10%	10%	10%	20%	10%	10%	CLO 1.1
Score	4.26	4.72	4.72	4.81	3.93	4.62	5	4.95	4.84	
	0.426	0.472	0.472	0.481	0.393	0.462	1	0.495	0.484	4.69

Table 4.3-CLO 1.1 For 100% Assessments based Evaluation without any examination

The resultant reading for CLO 1.1 here in Table 4.3 is 4.69, which is obtained when course 216-CSM was evaluated on the bases of semester wide weekly assessments and percentage of assessments is 100% part of the total evaluation. This is the mapping obtained without any final and mid examinations. The depicted reading 4.69 out of a total 5 suggests that CLO 1.1 is attained the best compared to previous two cases.

CLO 2.1

	Course Learning Outcome	CLO Domain	Theory							Lab		Score	
			Assignment 1	Assignment 2	Quiz 1	Quiz 2	Mid Exam	Final Quiz	Final Exam	Lab Exercises	Lab Exam		
2.1	Design solutions and solve problems computationally through the application of fundamental data structures and algorithms.	Skill	10%	10%	10%	10%	10%	10%	20%	10%	10%	4.41	100%

Weight	10%	10%	10%	10%	10%	10%	20%	10%	10%	CLO 2.1
Score	4.26	4.72	4.72	4.07	3.93	4.62	4	4.95	4.84	
	0.426	0.472	0.472	0.407	0.393	0.462	0.8	0.495	0.484	4.41

Table 4.4-CLO 2.1 For 100% Assessments based Evaluation without any examination

The resultant reading for CLO 2.1 here in Table 4.4 is 4.41, which is obtained when course 216-CSM was evaluated on the bases of semester wide weekly assessments and percentage of assessments is 100% part of the total evaluation. This is the mapping obtained without any final and mid examinations. The depicted reading 4.41 out of a total 5 suggests that CLO 2.1 is attained significantly.

CLO-2.4

Course Learning Outcome		CLO Domain	Assessments									Score	
			Theory							Lab			
			Assignment 1	Assignment 2	Quiz 1	Quiz 2	Mid Exam	Final Quiz	Final Exam	Lab Exercises	Lab Exam		
2.4	Articulate and present innovative ideas for solving varied computing problems using hybrid data structures with low complexities.	Skill	10%	10%	10%	10%	10%	10%	20%	10%	10%	4.27	100%

Weight (%)	10%	10%	10%	10%	10%	10%	20%	10%	10%	CLO 2.4
Score	4.35	4.72	4.72	4.81	2.88	5	3.7	3.93	4.88	
	0.435	0.472	0.472	0.481	0.288	0.5	0.74	0.393	0.488	4.27

Table 4.5-CLO 2.4 For 100% Assessments based Evaluation without any examination

The resultant reading for CLO 2.4 here in Table 4.5 is 4.27, which is obtained when course 216-CSM was evaluated on the bases of semester wide weekly assessments and percentage of assessments is 100% part of the total evaluation. This is the mapping obtained without any final and mid examinations. The depicted reading 4.27 out of a total 5 suggests that CLO 2.4 is attained average. Here the question arises why is this CLO depict the value which is not similar to the previous values attained in case of assessments without examination. The major point to ponder over here is that the CLO 2.4 is based on the high-level expertise, and that are attained not by the maximum of the students enrolled in the course but only few outstanding students meet up the criteria for that particular assessment. So, this is the maximum outcome for CLO 2.4.

CONCLUSIONS

In summary, to assess students learning the parameter defined is CLO. If the course is evaluated on the bases of CLOs and major CLOs are catered in the assessment process, by designing different kind of assessments based on specified category of CLOs, then it can be presumed that course is taught according to set quality standards. Course rating signifies overall academic standards of the university. Also, proper sampling of the students has key role in the accuracy of the studies. How well student outcome matches with CLOs depends on how well our assessments are aligned with CLOs, and how well we grade students' work. Betterment is observed in attaining CLOs if courses are fully designed based on semester wide assessments targeting each CLO separately. Course assessments mapped with CLOs generalize and identify things that are working well in your course, identify things that could be improved upon. It facilitates to make strategic revision of assessments in the future, and then evaluate the success of changes made in assessments design. CLO to student outcome mapping further depicts how a certain course fits in with the curriculum, whether there are gaps to fix or improvements that could be made. While assessment can be used in beneficial ways, the process of assessment does not

by itself improve student learning rather assessments are a process that helps to determine what is assisting to maintain quality of the course fully aligned with CLOs and what is distracting from CLOs.

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