Active Learning and Self-Study Approach for Cloud Computing

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Abstract

Background Study:

Cloud Computing course employed in various curriculum across colleges in India follow a teacher-centric approach and theoretical concepts teaching. This lacks practical skills and real-time project development by students and hence students find it difficult to implement and correlate the working in real-time.

Objectives:

In an outcome-based education, teaching learning methodology motivates students to learn the concepts and apply on real world scenario in developing a project. To enrich the project development skill of the students, a self-study component course was introduced in the curriculum named "Cloud Computing" for the under graduate students in the year 2021-2022, where students learn the concept and strategies in cloud scenario and developed a project to solve some real-world challenges in cloud. Self-study component introduced in the cloud computing course helped the students to learn the CloudSim simulation tool and carry out the project on real world strategies in cloud. Even self-study component helped the faculties to review the students based on rubrics and evaluate. The self-study approach helped the students to solve the problems with project techniques.

Methods, results, and conclusions:

The plan of activity discussed in the paper gives the students proper planning towards active learning and completion of their projects in time. Self-study component introduced in the cloud computing course helped the students to learn the CloudSim simulation tool and carry out the project on real world strategies in cloud. Even self-study component helped the faculties to review the students based on rubrics and evaluate. The rubrics-based evaluation makes the faculty in charge to evaluate the students impartially. The impact of active learning helped the students to concentrate more on the project techniques and concepts rather than learning programming construct. The paper demonstrated the effectiveness and students' reaction of active learning approach before the inclusion of self study component and after the inclusion of self-study component for the Cloud Computing course.

***Keywords*—Self Study; Project Based Learing; Rubrics Based Evaluation; Active Learning; Teaching Learning.**

I. INTRODUCTION

THE current technology demands the use of Outcome Based Education (OBE) which makes students to focus on outcomes rather than performance [1]. In order to incorporate OBE, the courses with the self-study component have been designed in the current curriculum to assist the interaction among students and maximize their learning capability with active participation and discussion [2][3]. Developing a project on real world challenges through active learning is one of the efficient techniques to promote OBE. The self-study component-based course is designed in the OBE scheme to provide ample time apart from the contact hours for the students to learn something new apart from the curriculum and develop projects based on the concepts learned [4]. The active learning in the OBE scheme also helps the trainer to review the concepts learnt by the students and evaluate based on the rubrics [5].

Project Based Learning (PBL) methods helps the students [6][7]:

- To work in a team, participate effectively as an individual, as a member or team leader.
- Follow ethical principles and commit to professional ethics and responsibilities.
- Communicate effectively, write effective reports and design documentation.
- Understanding of the engineering and management principles.
- Develop projects in multidisciplinary environments.
- Ability to engage independently and life-long learning in the broadest context of technological change.

In this paper, the design and assessment plans for the course "Cloud Computing" is discussed. The inclusion of self-study component in the comprehensive course was very challenging to most of the faculties. Furthermore, Cloud computing is a new and booming technology. Inclusion of comprehensive course for the Cloud Computing initially was very challenging. It was a continuous journey with regular meetings industry experts, alumni, students, faculties as well before the course started. Department of Computer Science & Engineering adopted active learning through projects and evaluate students based on concept learnt, project designed and presented. The methodology adopted and plan for the comprehensive course "Cloud Computing" have been discussed

in Section 2. The evaluation procedure used to assess student's active learning through projects has been discussed in Section 3.

II. METHODOLOGY

The main objective was to make the students engage in implementation of the project stage by stage during the course. Active learning is the integration of learning and doing [8][9]. At the beginning of the semester, the course handling faculty members shares the plan of activities among the students to carry out their projects for the course "Cloud Computing". Student's team of size ranging from 3-4 members were formed and choice was given to an individual team to select the project topic initially. The topic selected had to be on a real-time challenges in cloud. The main aim of working on real time challenges in cloud is to make students exposure towards current challenges in the cloud environment like task scheduling, load balancing among the servers, power consumption at the cloud etc and design and develop a project on the same.

Meeting were scheduled between the students team and faculties every fortnight where students presented work done till date. Based on their presentation, suggestions were given by the facuty incharge. Faculty incharge seriously reviewed suggestions given in the previous presentation incorporate and gave them the direction to gohead in desiging a wonderful projects. Reviews given by the faculty incharge really helped the students in completing their projects in the right direction and in a timely manner. Also, active learing approach enhanced communication and presentation skills of students. During the review process, the peers gave additional inputs for further improvements of the project.

A. Plan of Activity for "Cloud Computing" Course

Under self-study component of "Cloud Computing" course, students had to carry out a project work of developing a task scheduling, load balancing among the servers, comparison on various task scheduling approaches, comparision on various load balancing approaches, centralized and distributed scheduling approaches etc. Duing the project tenure, students initailly learnt the installation of Eclips, CloudSim tool [10][11], Students understand working environment of CloudSim tool, demonstration of few examples in CloudSim tool. They started designing a project on the chosen problem statement using CloudSim tool [12]. The plan of activities is shown in Table 1.

TABLE I
PLAN OF ACTIVITIES FOR SELF-STUDY PROJECT DEVELOPMENT

Sl. No	Week	Probable Dates	Activity
1	Week-1 and Week-2	3rd to 14th Oct 2021	Formation of groups Note: Students group of size 3 to 4
2	Week-3	17th to 22nd Oct 2021	Problem statement selection by each group- Review 1
3	Week-4	24th to 29th Oct 2021	Installation of required software's Eclipse and CloudSim/Cloud Analyst into their Laptops systems
4	Week-5	2nd to 7th Nov 2021	Modification based on reviews from the faculty in charge and finalizing the problem statement
5	Week-6	8th to 14th Nov 2021	Analyzing various examples given in the simulator
6	Week-7	16th to 20th Nov 2021	Presentation of analyzed examples by each group
7	Week-8, Week-9, Week-10	23rd Nov to 11th Dec 2021	Implementation of chosen problem statement using the simulator
8	Week-11	13th to 17th Dec 2021	Demonstration of designed part by each group-Review 1
9	Week-12	20th to 24th Dec 2021	Modification based on reviews from the faculty in charge and demonstration of extended work by each group-Review 2
10	Week-13	27th Dec to 2nd Jan 2022	Report preparation
11	Week-14	4th to 6th Jan 2022	Report submission and approval

III. COURSE END SURVEY AND RUBRICS FOR PROJECT EVALUATION FOR THE "CLOUD COMPUTING" COURSE

Table 2 depicts Course Outcomes (CO) designed for the "Cloud Computing" course. CO3 is designed in order to explore Cloud simulator and implement a scheduling algorithm for cloud resource sharing scenario. The course outcome for Cloud Computing course is designed to achieve the higher-level Program Outcomes (PO) such as PO3, PO9, PO10 and PO12. The CO-PO Mapping for Cloud Computing course is depicted in Table 3.

TABLE II
COURSE OUTCOMES FOR "CLOUD COMPUTING" COURSE

CO1	Ability to analyze technological concepts of Cloud Computing
CO2	Ability to analyze technological concepts of Cloud Computing
CO3	Ability to explore Cloud Simulator and implement a scheduling algorithm for cloud resource sharing scenario

TABLE III
CO-PO MAPPING FOR "CLOUD COMPUTING" COURSE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3			3						2	2		2

The two methods of assessment for computing the CO attainment are direct and indirect were used for Cloud Computing course

- The direct assessment is computed through Continuous Internal Evaluation (CIE) which includes of Theory Tests, Quiz/Alternate Assessment Tool (AAT)/Self Study Component and Laboratory Component.
- The indirect assessment is done through Course End Survey (CES) which is taken at the end of the semester from the students based on the topics learnt in the course. The CES questions are designed to be mapped to the Course Outcomes and also CES rubrics are framed for evaluation of the indirect assessment [13][14] as shown in the Table 4.

TABLE IV

COURSE END SURVEY RUBRICS FOR "CLOUD COMPUTING" COURSE

Criteria	Exemplary	Proficient	Partially Proficient	Points
Implementation	Ideal implementation for all set objectives. (4)	Appropriate implementation for most of the set objectives. (2)	Concern to implementation for a few set objectives. (1)	___ / **4**
Report	Clear and Effective writing and adherence to appropriate style guidelines (2)	Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines (1)	Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines (0.5)	___/**2**
Oral communication (presentation)	Clear and effective communication (2)	Communication is clear (1)	Unclear communication (0.5)	___/**2**
Team Work	Actively participated as a team member (1)	Partially participated as a team member (0.5)	No participation (0)	___/**1**
Participation in the Discussions	Provided many good ideas; inspired others; clearly communicated ideas, needs, and feelings. (1)	Participated in discussions; on some occasions, made suggestions. (0.75)	Listened mainly; Rarely spoke up, and ideas were off the mark. (0.5)	___/**1**
Total				__/ **10**

IV. COMPARISON ON WITH SELF-STUDY COMPONENT AND WITHOUT SELF-STUDY COMPONENT FOR "CLOUD COMPUTING" COURSE

The results of Course End Survey in terms of percentage is illustrated in Table 5. Figure 1 shows the comparison on course end survey results (in %) for "Cloud Computing" course before inclusion of self-study component and after the inclusion of self-study component. Figure 1 illustrates students' appreciation in inclusion of self-study component in the course and development of a project through active learning approach. Figure 2 and Figure 3 shows pie chart of Course End Survey for "cloud computing" course before inclusion of self-study component and after the inclusion of self-study component. From the course end survey result, it is evident that most of the students have given an "Excellent" rating which reflects that self-study approach is an efficient method of teaching pedagogy.

The skills of the student were depicted all through the phases of the project implementation such as planning, designing, implementing and presentation. In order to achieve Program Outcomes: PO3, PO9, PO10 and PO12 such as designing, participation in the team, communication and presentation as well as lifelong learning was introduced as part of self-study.

TABLE V
COURSE END SURVEY RESULTS (IN %) FOR "CLOUD COMPUTING" COURSE

	Before Inclusion of Self Study Component in %	After Inclusion of Self Study Component in %
Excellent	48.5	68.8
Good	49.7	28.9
Average	0	0
Poor	1.8	2.1

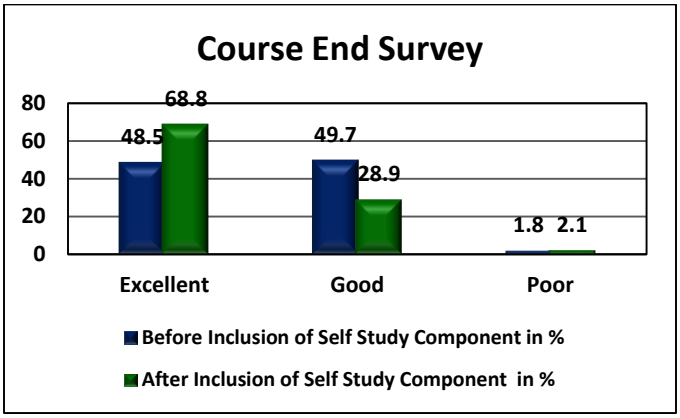

Fig. 1. Course end survey results (in %) for "cloud computing" course

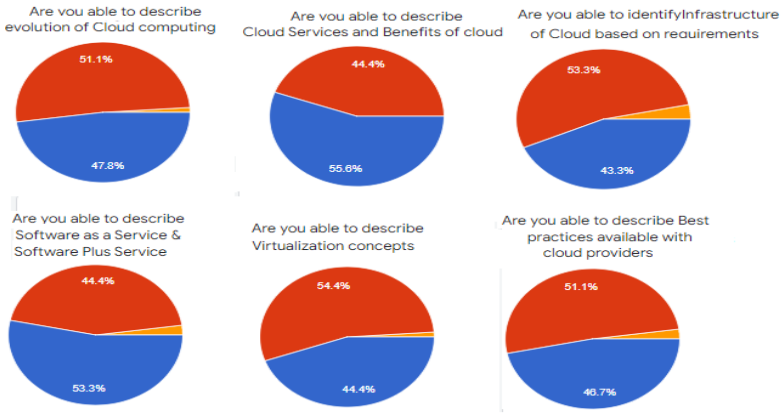

Fig. 2. Course end survey results (in pie chart) for "cloud computing" course before inclusion of self study component

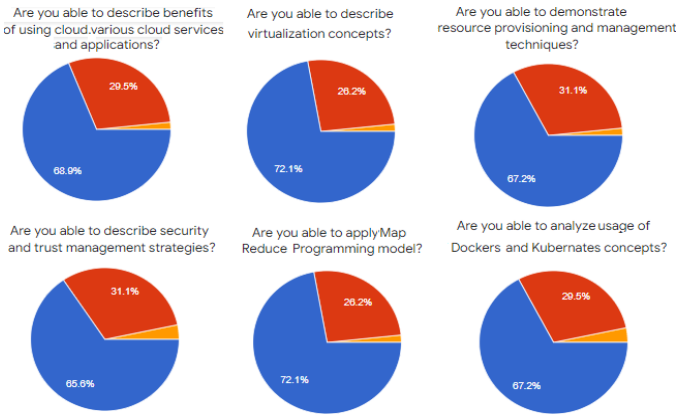

Fig. 3. Course end survey results (in pie chart) for "cloud computing" course after inclusion of self study component

V. COMPARISON ON WITH SELF-STUDY COMPONENT AND WITHOUT SELF-STUDY COMPONENT FOR "CLOUD COMPUTING"

The challenges faced during implementation of self-study component through projects for Cloud Computing course are:

- Understanding CloudSim simulation tool and various modules within it
- Survey on various current task scheduling and load balancing techniques and Identification of the problem statement.
- Initially, student found this approach very hectic but based on timely guidance by faculty in charge they were able to accept the new approach of active learning.
- Timely review and guidance to the entire project groups in a class.

VI. CONCLUSION

This paper discussed the design and assessment plans towards implementation of active learning for "Cloud Computing" course for undergraduate students. The plan of activity discussed above gave the students proper planning towards active learning and completion of their projects in time. Self-study component introduced in the cloud computing course helped the students to learn the CloudSim simulation tool and carry out the project on real world strategies in cloud. Even self-study component helped the faculties to review the students based on rubrics and evaluate. The rubrics-based evaluation makes the faculty in charge to evaluate the students impartially. The impact of active learning helped the students to concentrate more on the project techniques and concepts rather than learning programming construct. The paper demonstrated the effectiveness and students' reaction of active learning approach before the inclusion of self study component and after the inclusion of self-study component for the Cloud Computing course.

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Ethical approval:
All authors whose names appear on the submission
1) made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work;
2) drafted the work or revised it critically for important intellectual content;
3) approved the version to be published; and
4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
Consent to participate: None

Consent for publication:
All authors whose names appear on the submission
1) made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work;
2) drafted the work or revised it critically for important intellectual content;
3) approved the version to be published; and
4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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REFERENCES

[1] Wael Sh. Basri, Jehan A. Alandejani, Feras M. Almadani, "ICT Adoption Impact on Students' Academic Performance: Evidence from Saudi Universities", Hindawi Education Research International, Volume 2018, Article ID 1240197, https://doi.org/10.1155/2018/1240197.
[2] Sun, P. H, Lee, S. Y, "The importance and challenges of outcome-based", education – a case study in a private higher education institution. Malaysian Journal of Learning and Instruction, 17(2), 253-278, 2020, https://doi.org/10.32890/mjli2020.17.2.9.
[3] Shazia Iqbal, Ian Willis, Turky H. Almigbal, Abdullah Aldahmash, Samer Rastam, "Outcome-based education: evaluation, implementation and faculty development", MedEdPublish, 2020, DOI: doi.org/10. 15694/mep.2020.000121.1.
[4] Christina Gloerfeld, Silke E. Wrede, Claudia de Witt, "Recommender – Potentials and Limitations for Self-Study in Higher Education from an Educational Science Perspective", International Journal of Learning Analytics and Artificial Intelligence for Education. Special Issue: Positioning Artificial Intelligence in Education - Evidence and Reflections. 2, Volume 2, pp.34-45, 2020, DOI: doi.org/10.3991/ijai. v2i2.14763.
[5] Florence Martina,Albert Ritzhauptb, Swapna Kumarb, Kiran Budhrani, "Award-winning faculty online teaching practices: Course design, assessment and evaluation, and facilitation", The Internet and Higher Education, Elsevier, Volume 42, July 2019, pp. 34-43, DOI: doi.org/10.1016/j.iheduc.2019.04.001.
[6] Aashish Sharmaa, Himanish Duttb, Ch. Naveen Venkat Saic, Santosh Madeva Naik, "Impact of Project Based Learning Methodology in Engineering", Procedia Computer Science, Elsevier, 172, pp.922–926, 2020.

[7] Mohammed Abdullatif Almulla, “The Effectiveness of the Project-Based Learning (PBL) Approach as a Way to Engage Students in Learning”, Sage Open, 10(3), pp.1-15, September 2020, DOI:10.1177/215824 402093870.
[8] https://en.wikipedia.org/wiki/Project-based_learning.
[9] Marcela Hernández-de-Menéndez, Antonio Vallejo Guevara, Juan Carlos Tudón Martínez, Diana Hernández Alcántara, Ruben Morales-Menendez, “Active learning in engineering education. A review of fundamentals, best practices and experiences”, International Journal on Interactive Design and Manufacturing, Springer, 13(3), pp.909–922, 2019, DOI: doi.org/10.1007/s12008-019-00557-8.
[10] https://www.superwits.com/library/cloudsim-simulation-framework/course-content-cloudsim/intr oductiontocloudsimpackage.
[11] https://www.cloudsimtutorials.online/cloudsim-setup-using-eclipse/.
[12] A R. Arunarani, D. Manjula, Vijayan Sugumaran, “Task scheduling techniques in cloud computing: A literature survey”, Future Generation Computer Systems, Elsevier, pp.407-415,2019.
[13] Katherina Gallardo, “Competency-Based Assessment and The Use of Performance-Based Evaluation Rubrics in Higher Education: Challenges Towards the Next Decade”, Problems of Education in the 21st Century, 78(1), pp.61-79, 2020.
[14] Leticia-Concepción Velasco-Martínez, Juan-Carlos Tójar-Hurtado, “Competency-Based Evaluation in Higher Education—Design and Use of Competence Rubrics by University Educators”, International Education Studies, Published by Canadian Center of Science and Education, 11(2), ISSN 1913-9020, 2018.