PalArch's Journal of Archaeology of Egypt / Egyptology

OUTCOME-BASED EDUCATION FOR COMPUTER SCIENCE IN E-LEARNING THROUGH MOODLE

Basetty Mallikarjuna[a], Dayananda P [b] Niranjanamurthy M [c], Pardeep Kumar[d], Munish Sabharwal[e]

[a]School of Computing Science & Engineering, Galgotias University, Greater Noida, Uttar Pradesh 203201, India. E-Mail: basetty.mallikarjuna@galgotiasuniversity.edu.in

[b]Professor and HOD, JSS Academy of Technical Education, Bengaluru, Pin.: 560060, India E-Mail: dayanandap@gmail.com

[c]Assistant Professor, Department of Computer Applications, M S Ramaiah Institute of Technology, Bangalore, Pin.:560054, India. E-Mail: niruhsd@gmail.com

[d]Pro Vice Chancellor, Galgotias University, Greater Noida, Uttar Pradesh 203201, India, pvckumar@galgotiasuniversity.edu.in

[e]Professor and Dean School of Computing Science & Engineering, Galgotias University, Greater Noida, Uttar Pradesh 203201, India. E-Mail: mscheckmail@yahoo.com

*Corresponding Author: Basetty Mallikarjuna, School of Computing Science & Engineering, Galgotias University, Greater Noida, Uttar Pradesh 203201, India.

Email: basetty.mallikarjuna@galgotiasuniversity.edu.in

Basetty Mallikarjuna, Dayananda P, Niranjanamurthy M, Pardeep Kumar, Munish Sabharwal, Outcome-based Education for Computer Science in E-learning through Moodle-Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(9), ISSN 1567-214x

Abstract

Outcome Based Education (OBE) is a part of our education system in current scenario. In particular, E-learning in Computer Science, there are so many tools used in OBE to achieve a specified outcome, like Moodle. We introduced a new teaching pedagogy algorithm through Moodle and it was implemented in Galgotias University in India to make OBE as an effective methodology on Program Specific Outcomes (PSO). It had been proved on MATLAB software that, the Course Outcomes (CO) and the Program Outcomes (PO) attainment through integrated OBE (iOBE). This paper is a comparison between the didactic teaching methodology and Moodle Teaching Learning (T-L) tool in computer science education and proved that importance of Moodle as an effective T-L tool in computer science education.

Keywords: OBE, Moodle, Computer Science, E-learning, Course Outcomes, Programme Outcomes, iOBE;

1 Introduction :

Moodle is a popular learning tool for new age learners that can be used for E-Learning in Computer Science education and can be developed with the pedagogical principles. There is difference between traditional teaching techniques and OBE, Moodle Teaching-Learning (T-L) tool helps the learners to understand and develop quality education, active learning and other E-learning projects are required for computer science education (Ryback, D., & Sanders, J. J. 1980). The course is expected to help the leaner should reach the goal (Ryback, D., & Sanders, J. J. 1980). No one could propose the exact T-L methodology and assessment methodology in OBE. It is indispensable for Computer Science curriculum to embrace new teaching methodologies to run classes and assignments and thus help the learners. The following ICT technologies are associated with OBE (Passey, D. 2017; Kimn, H, J., 2015).

The concept of OBE is flipped classroom supported to the Moodle free source E-learning software toolkit, the flipped classroom relies on virtual learning management system (Lo, C.K., & Hew, K, F., 2017; Lents, N, H., & Cifuentes, O. E., 2009).

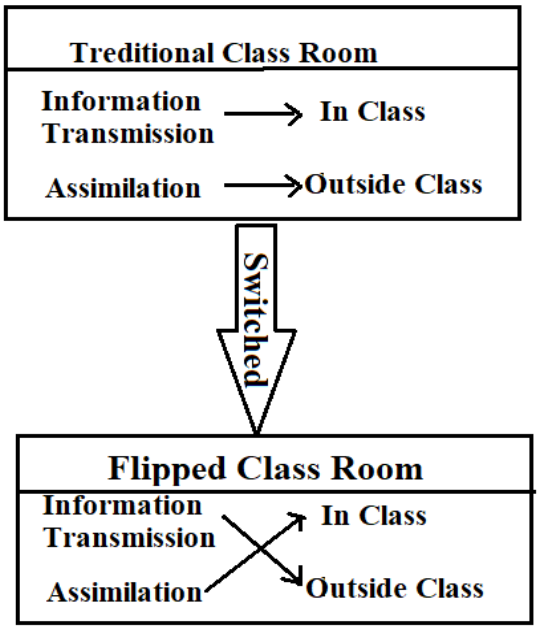

Figure 1: How flipped classroom differs from the traditional classroom (Carvalho, A., 2015).

Flipped Class Room is a type of engaged learning. The educator delivers an instructional content online, the student goes through this online content outside from wherever they are and student does the activities related to the online content and assimilation can be done inside the classroom. As per Figure 1.1, traditional classroom teacher delivers the content with excitement but doesn't know how many of his students actually attentive (Abeysekera, L., & Dawson, P., 2015; UCISA., 2010). In flipped classroom concept, the information transmits happens outside the class and assimilation happens inside the class. This as shown in Figure 1.1 and Figure 2. If students have gone through the online contents or collaborate with the online discussions in their home, they engage the

concept in the classroom with the guidance of a mentor (Ronchetti, M., 2010; UCISA., 2012). e.g; In flipped classroom method, think pair share (TPS) activity students watch 10-15 minutes video at their houses and work on the exercises to the learned video in the classroom (Passey, D., 2015).

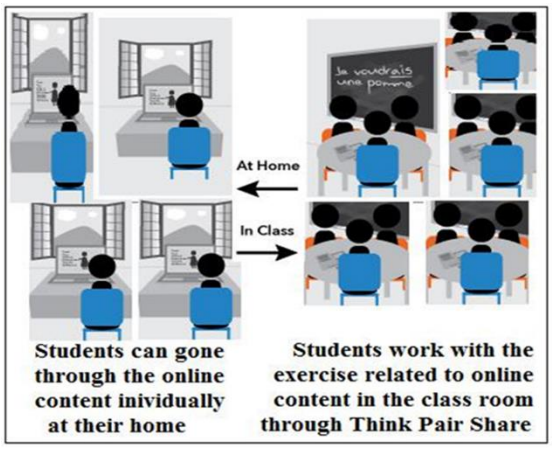

Figure 2: Flipped Classroom (Lo, C, K., & Hew, K, F., 2015).

Class is a period of time, that spent in assimilation rather than information transmission, in other words, class period focuses on higher cognitive levels (apply, analyze, create), rather than on lower levels (understand, remember). The flipped class room is not only watching videos but also it is the in-depth learning with personalization discussions with their fellow learning members through their smart-phone (Strayer, J, F., 2012; UCISA., 2014). The learning environment becomes effective with engaging relevant, authentic, fun, peer based, technical involvement, project-based learning, making real-world connections, using physical movement, student choice and using visuals.

This paper defines the B.Tech Computer Science & Engineering students at Galgotias University in India, the students can gain knowledge through E-learning via Moodle. This was conducted in the School of Computing Science & Engineering at Galgtias University in India 17.07.2018-31.11.2018, on Vth Semester B.Tech students. The results of this paper shows, two groups of students were taught the same topics by two different T-L activities i.e., through Moodle and via didactic lectures. Assessment of knowledge was done for e-learning through Moodle via feedback form. The results proved that Moodle T-L tool is effective when compared to didactic teaching, and the CO-PO mapping and attainment has been evaluated through the iOBE software proved that, E-learning through Moodle is more effective T-L tool. It has been studied extensively and compared with the didactic teaching, in spite some caveats, there is no doubt that E-learning through Moodle is an effective T-L tool. Section 2 describes the related work, in section 3 proposed pedagogy has been explained, section 4 describes the results and discussions and section 5 ends with the conclusion.

2 Related Work:

The term Moodle was introduced by Stephen Downes and George Siemens in the year of 2008. Moodle T-L tool has gained popularity during the period of 2012- 2018 in various top universities in USA like

Stanford, Pennsylvania, MIT, Harward, Washigton and Michigan (Voogt, J., et al., 2015; Van Niekerk, J., 2015). The demand of branch computer science gained popularity in 2000, however it lacked teaching methodologies to teach computer science subjects. Moodle is flexible T-L tool to learn (Lo, C, K., & Hew, K, F., 2015), thus many were attracted to join the programme in computer science, as per statistics of all university offered Moodle T-L tool compulsory for their education system (U3A Online., 2015).

Number of courses can be introduced using the Moodle open-source platform, more than 900 universities have courses on Moodle and 101 Million students joined Moodle's courses out of which 37 million registered users were of Coursera and 18 million of edx. Coursera and edx are top two globally popular Moodle platform of year 2018 (UK Digital Skills Taskforce., 2014). While introduced Moodle T-L tool the learner's dropout rate is also decreased, as per the research. In didactic teaching, learners get bookish knowledge rather than practical knowledge ((Lo, C, K., & Hew, K, F., 2015).

Moodle mobile application is currently one of the most popular social networking platforms, it is a most popular application on smart-phones and was routinely used by almost all of the learners (Bottino, R, M., et al., 2009) however the study does not discuss about the CO-PO attainment. Dyavarishetty and Patil, (2017) proposed WhatsApp T-L tool for learners in the second year MBBS, it does not serve as an 'effective T-L tool for E-learning (Ryback, D., & Sanders, J, J., 1980). Proposed WhatsApp as a learning tool in medicine, they observed pre-test scores and post-test scores but didn't find the same appropriate for the learners (Bottino, R, M., et al., 2009).

Compared WhatsApp T-L and didactic teaching T-L, but the results in medicine and pathology proved that WhatsApp is effective T-L tool. However, as per the learner's point of view, WhatsApp T-L is not satisfactory (Passey, D., 2017). Passey, D., (2015) also proved proved that Moodle is effective T-L tool and their results are recommended by 92% learners. Computer Science learners explore certain opportunities worldwide. Throughout human life and industries had always depended upon computer (Marks, D. B., 2015).. Learners identifying to join top international colleges for getting admission in computer science because of employments (Carvalho, A., 2015).

Learners are not only interested to join for placements but also to gain actual knowledge of computer science. Most international organizations target 85-95% placements to targeted the students. The job opportunities in the USA and demand of computer science in the USA as shown in Figure 3. as per the statistics of labor buro USA (Marks, D. B., 2015).

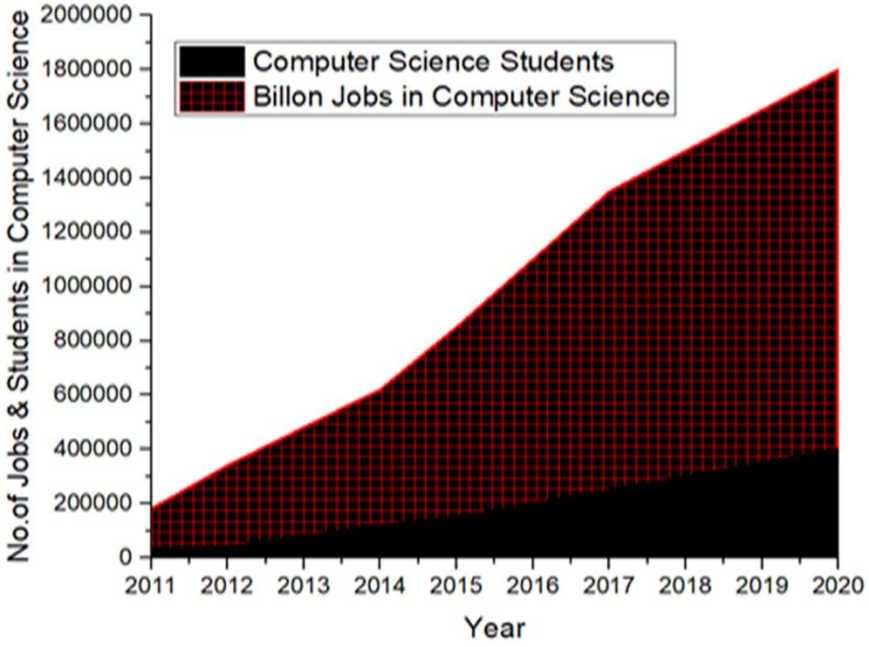

Figure 3: Job Opportunities and Demand in Computer Science (USA) (Marks, D. B., 2015).

Dagiene, V., (2015) study have some limitations; it contains one aspect of learning in medicine, mentor and mentee interaction is missing, though most of the learners accepted this learning design, it has not achieved 100% satisfactory report. Mandate based T-L process is not discussed in this study . Sung et al., (2016) study learners feel less motivated, most of them performed poor in the questionnaire (EDUsmmIT., 2015). However, this study described on medicine in the subject of pathology and anthropology (Grandbastien, M., 2015). This study helped learners to understand teaching activities. Computer-assisted teaching is not implemented in this study, it lacks face to face interaction, this is not suitable for regular learners, longer assignments should be conducted for learners (Abeysekera, L., & Dawson, P., 2015). Integration of online face to face interactions has been covered, the subject facilitator, duration of the length of the syllabus is not covered (Koivisto, J., 2015). This study is not ideal for computer science education (Leahy, D., (2015).

This paper proposed new teaching of pedagogy and observed the results conducted for 82 B.Tech (Comp Science and Engineering) students, divided into two groups (41 learners in each section for the subject of compiler design), applied both didactic teaching methodology and E-learning through Moodle. Especially some of the subjects have both theory and practical, minimum 14 practical sessions were asked at each laboratory subject. The Moodle asked to answer the feedback questionnaire related to their perception of Moodle methodology of teaching. The learning process is learner-centered rather than lecture as in conventional approach. An OBE majorly focuses on the learners and organizes everything in the curriculum in such a way that the students are benefited to the maximum and also ensures that every student learns at least the essentials by taking a proper and timely assessment of the learning.

OBE in 2009 through Washington accord, integrated the CO-PO attainment to a large extent, an OBE is a bottom-up approach for designing a curriculum of any course (Ryback, D., & Sanders., J, J., 1980). First, we will set an outcome that is expected by the learners after completion of the course and based on that we will start designing curriculum to achieve an expected outcome (Passey, D., 2017; Bottino, R, M., et al., 2009). An OBE doesn't follow a strict guideline for any course; it relies on individual understanding and need of students what goals to be set and how to achieve those (Carvalho, A., 2015). OBE is the experimental model rather than theory, and Moodle T-L is a compulsory part of OBE, US government passed the bill to implement OBE under the part of Moodel T-L [5]. In USA most of the top universities Stanford, Pennsylvania, MIT, Harvard, Washington started OBE and Moodle T-L tool in Computer Science from the year of 2002 (Dagiene, V., 2015). Mandate based teaching learning is not discussed any aforementioned study.

The CO-PO mapping matrix evaluated results using two software modules presented in iOBE 5.2 software such as iOBE Calculator and iOBE Aggregator. The iOBE5.2 software can run on Matlab2016b as executable files with GUI. The two modules separated with their own features; iOBE calculator calculates success for a course and provides each course performance of the learner and iOBE Aggregator aggregates the success and provide the average performance of the learner (Saito, T., 2015). The mathematical model iOBE software was designed by the Z. Mohamed-Kassim (2015), this assessment used to provide performance of learner assessment in examinations to measure their success that provides aggregation.

3 Methodology:

Galgotias University (India) implemented E-learning through Moodle in computer science education that allows learners to learn anywhere and anytime to learn computer science. E-learning can help to implement Moodle, it generates the E-Learning for current Computer Science and Engineering for a learner-centered approach. Mobile learning is the most suitable tool to learn programming languages of computer science subjects C, C++, JAVA. E-learning can be comprehended by knowing concepts in multiple contexts, in any social media and content interactions, using personal device such as MP3 players, notebooks, smart phones, and tablets etc. Computer science Engineering consists of two types of teaching theoretical teaching and practical teaching. Theoretical Teaching: It provides learner centered approach, each theoretical session goes to the discussion forum, and one practical session. The practice session contains an assessment, that assessment decides the performance of the learner. Practical Teaching: Each student before attending the practical session completes the observation of the current program that to be planned or prepared as an algorithm. In each practical session the content should be described before in Moodle. In the practical session, each student has to present the demonstration differently and conduct viva voice examination of a mentor as per the continuous evaluation, submit a report of the overall session, viva voice examination of each session and allotted to the grade. If programs are big then divide the students into different groups and conduct the practical session. Each practical session group has followed the specific instructions.

Algorithm 1: Teaching-Learning Process on Regular Basis

Step 1: Galgotias University started academic management system online named 'GU Master Soft RF Campus' a management system that helps the university to create course material transactions, duration and length of syllabus, academic transactions, reports faculty substations, lecture plan etc. This management system is a high-performance, user-friendly, and scalable for faculty to manage the learners, this is also used for student registration, attendance management, as per the syllabus definition prepared by the course breakups to upload, it is simple to access, GU Master Soft RF Campus as shown in Figure 4.

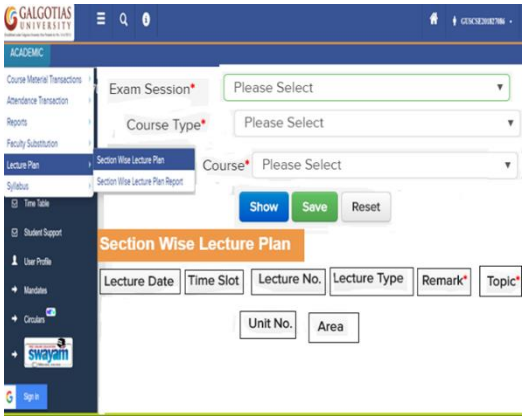

Figure 4:GU Mater Soft RF Campus screen shot.

Step 2: In addition to that, it implemented QBMS (Question Bank Management System) to create an environment in which CoE (Controller of Examinations) and School of Computer Science and Engineering predicted the quality bar in the processes of examinations. The quality bar can be consistently maintained without having to manually review the process at every stage of question paper generation and printing. On the contrary, QBMS's gives flexibility to the course coordinators and deans to manage the examination process while helping to achieve a desired consistency in the quality of questions for exams. In light of the above goal of the process, QBMS is designed to automate the workflow of following functions of designing questions paper:

Step 2a: Exam dates and actors (users who participate in this workflow) setting

Step 2b: Question paper template or pattern designing

Step 2c: Choosing the right question paper template for upcoming exam.

Step 2d: Designing questions for the upcoming exam as per the question paper template.

Step 2e: Generate questions paper and Print.

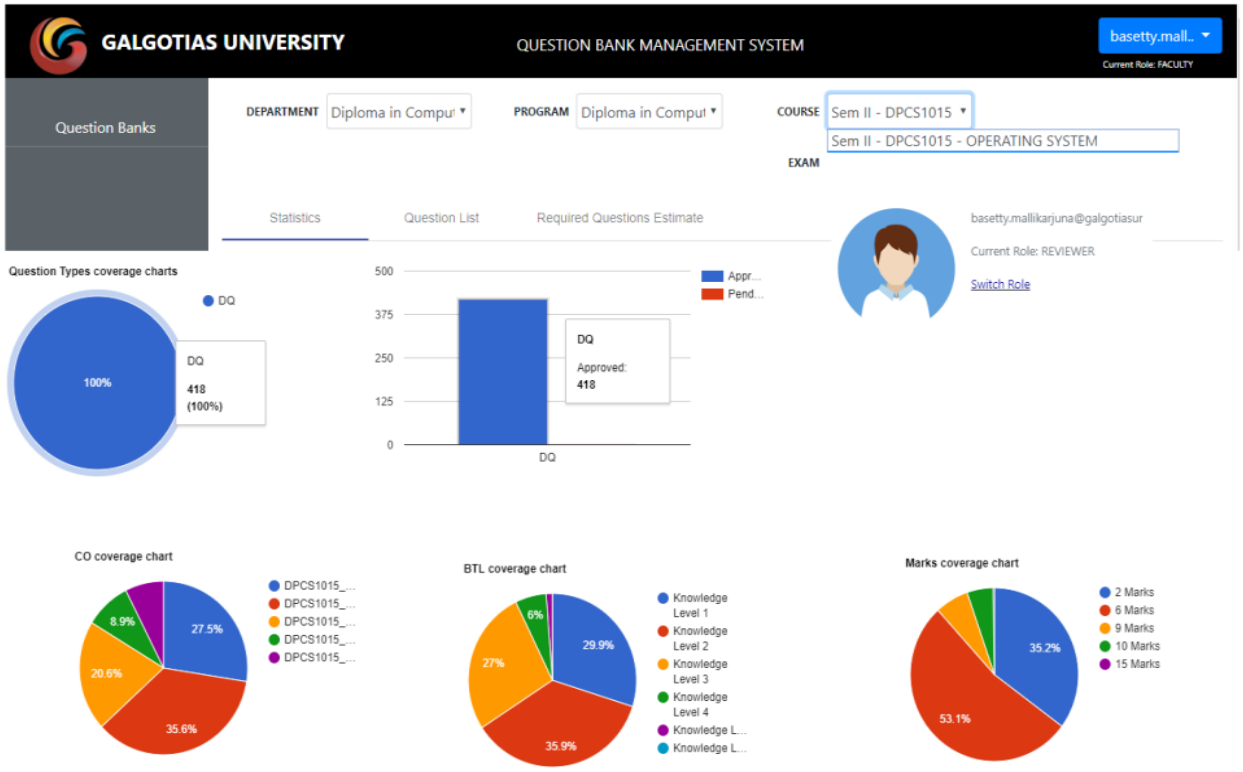

Figure 5:GU Mater Soft RF Campus screen shot.

.

Step 3: The end of each unit conducts continuous assessment tests (CAT), and external examinations as per the QBMS, if it not reaches the target attainment then continue with established CO's and improve the CO-PO attainment for next semester. Learning Management System (LMS) is the online framework built by the instructors, to create the new environment and facilitate personalized schooling, uploading video lectures, assessments, through the LMS as shown in Figure 6. LMS is very useful for education in higher degrees and provide security specifications and huge amount of information sharing and implementation of submission the assessments on online. In Computer Science the corresponding practical session of video or images has been release before the practical session through the LMS.

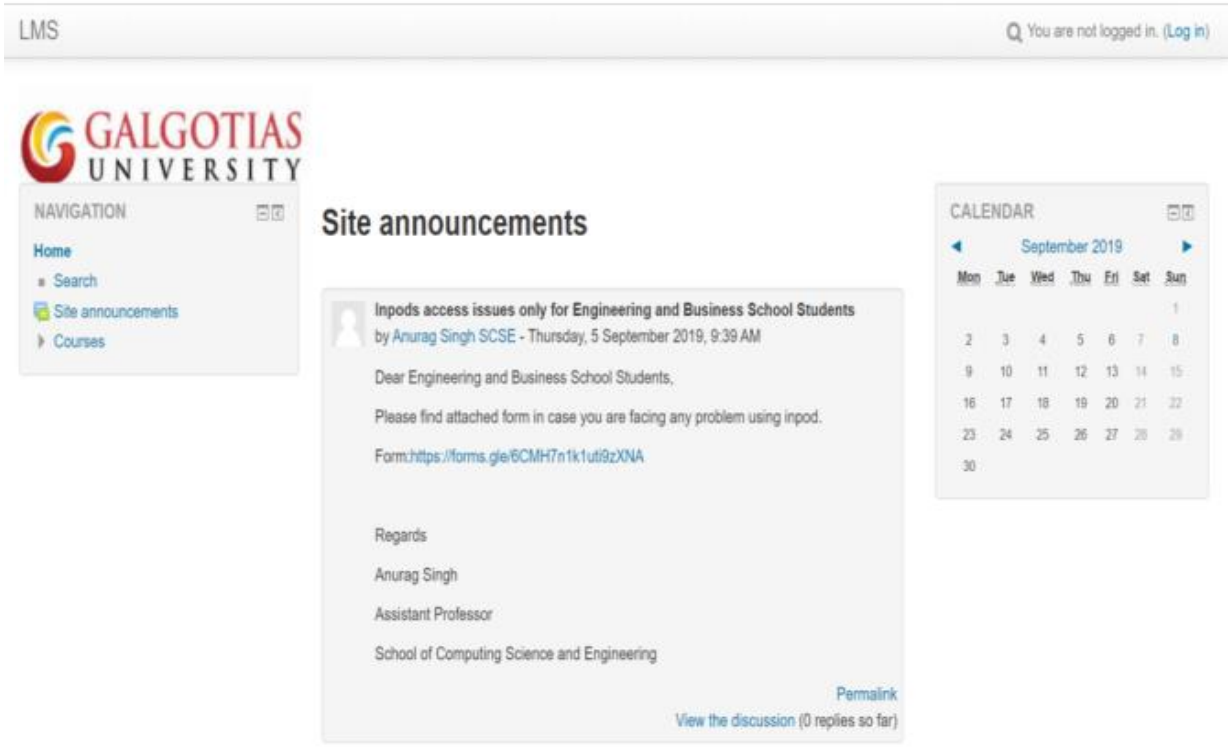

Figure 6:LMS screen shot.

Learners can watch the video lecture in LMS, after watching the video learners get the knowledge at the teaching position, here provide the peer-to-peer teaching. Learners got notifications and efforts are recorded accordingly as per the duration of the course.

Step 4: Repeat the steps 1, 2 and 3 as per the aforementioned pedagogy.

4 Results and Discussion:

The three-domain of learning i) Cognitive ii) Affective iii) Psychomotor, teacher can identify the understanding the classic levels of learner such as 'knowledge, attitude, and skills. A cognitive domain defines the learner knowledge for all competencies. Effective domain decides the quality of the learner either rule-following or rulemaking. A psychomotor domain defines the primarily acquisition of technical skills. Here we implemented iOBE 5.2 software on MATLAB 2016b, to define course objectives and program goals of the subject. Compiler design to give Excel file as an input file, this file acted as input file to generate graphs in MATLAB. It includes learner information and mapping the course objectives to corresponding program goals, the iOBE 5.2 software run on MATLAB compiler and it generates the iOBE calculated and iOBE aggregator. iOBE5.2 software computes the learning objectives for each course and plotted the graphs for individual learners for the corresponding course given, the course name as Compiler Design course in Galgotias University in India and plotted graph analyze the performance of Compiler Design course. The name of Excel input file is Compiler Design Info.xlsx as shown in Table 4.1. The CO mapped to the 12

PO's unique, each assessment of how many learners attained CO's and PO's. As per program state outcomes (PSO) Engineering knowledge and problem analysis and design/ development of solutions, the mapping CO corresponding PO is evaluated using Low, Medium and High.

PSO	CO's for Compiler Design	PO's for Compiler Design											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Engineering Knowledge & Problem Analysis	**CO1:** Develop Lexical analysis and syntax analysis using tools (Lex/Yacc).		High							High			
	CO2: language processing system, various phases of compiler			High						Low			
	CO3: To understand how the lexical analysis is working						High			Low			Low
Design / Development of Solutions	**CO1:** Design and implement a compiler for a simple language.							High					
	CO2: To understand how the Syntax and semantics analysis is working, how to define the syntax and semantics of various language constructs.		High			High							
	CO3: To understand how the intermediate code, code generation, code optimizer phases are working.			High				Low					
	CO4: Appropriate tools for developing each phase of compiler					Low	High						

Table 1.1: Excel Input file for the Compiler Design CO and PO.

The three taxonomies (Low, Medium, High) define knowledge-based goals, skill-based goals, and affective goals. iOBE5.2 software produce two different components such iOBE calculator and iOBE aggregator as shown in Figure 7.

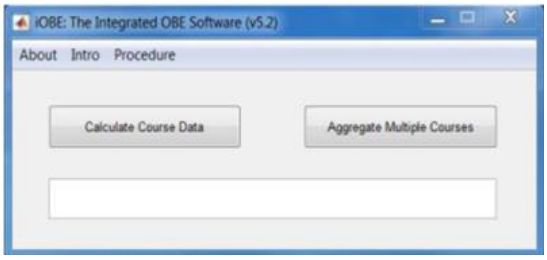

Figure 7:iOBE 5.2 Calculator and Aggregator

iOBE aggregator integrates and produces the resultant output graphs. This software can compute the CO for each and every learner and aggregates. It can compute and plot the graph of each student's performance to the achieved course outcomes as per the given Excel input file. The iOBE aggregator received the input Compiler Design Info.xlsx that file aggregated whole class of learners and can plot the graph as follows. Here I considered the compiler design course of 41 learners and obtain the result of CO and PO as shown in Figure 8.

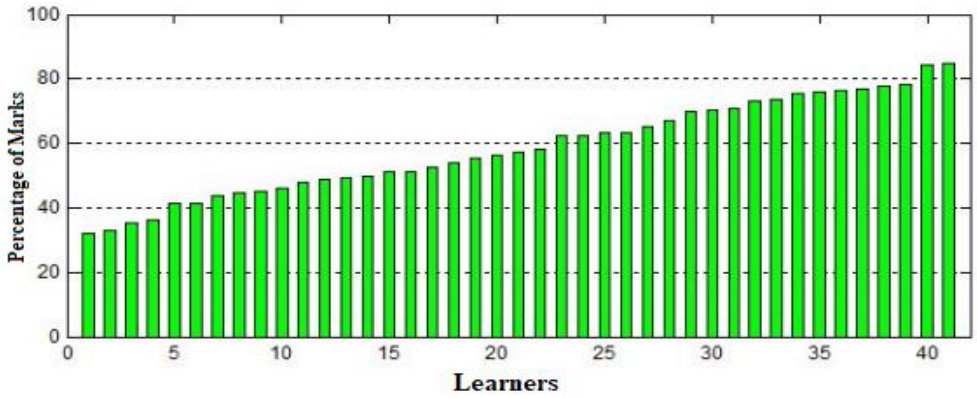

Figure 8: 41 students performance compiler design

iOBE calculator calculates each student learning outcomes of the corresponding course, the OBE must be required for the National Board of Accreditation (NBA), India. The CO is mapped with the common PO, each student CO is based on the outcome and it achieved of the maximum, targeted, average, reached and start with minimum value of percentage of marks is shown in Figure 9.

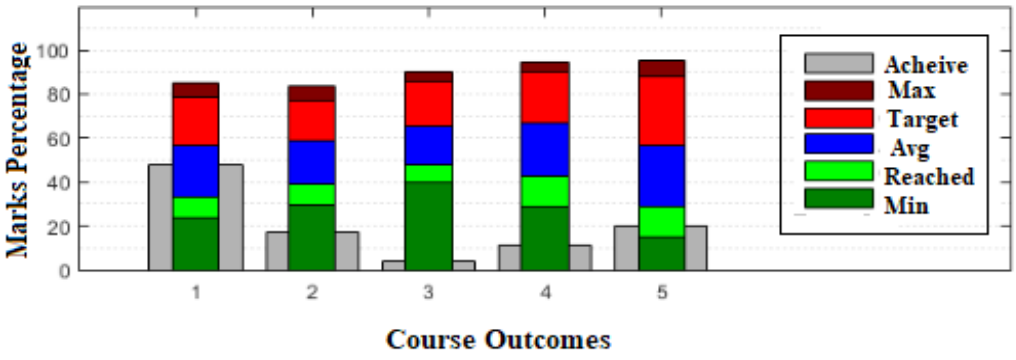

Figure 9: Course Outcomes on percentage marks

5 Conclusions:

In this study recommended E-learning through Moodle and expressed high level of satisfaction of the learners. Galgotias University implemented OBE and provide student-friendly environment, students can own gaining knowledge to perform activities, projects, and perform their own research projects, hands-on experience from real life situation. In this paper, the result

section proves that CO-PO mapping and attainments used in iOBE5.2 software and it is effective and efficient analyser of performance in the T-L process.

The demand of the Computer science is increasing for the next generation. In the future, the skills of learners with new pedagogical principles would definitely be improved and place it at par with the real-time demand.

Acknowledgment

I humbly like to thank the respected honourable chancellor Mr. Sunil Galgotia, Galgotias University India, and respected CEO Mr. DhruvGalgotia for providing and create health environment for successfully implemented of OBE in Galgotias University. I convey my gratitude to Vice-Chancellor, Pro-Vice Chancellor, Dean School of Computing Science and Engineering, Programme chairs, committee members who supported me with love and understanding. They provided me their most valuable time, patient guidance and advise throughout this work, without their cooperation and contribution, this study could not have been undertaken. I would like to acknowledge everyone who was a part of Galgotias University and my dear colleagues and my students for their continuous support to complete this work

References:

1. Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. Higher education research & development, 34(1), 1-14.
2. Biggs, J. (2003). Aligning teaching and assessing to course objectives. Teaching and learning in higher education: New trends and innovations, 2(April), 13-17.
3. Bottino, R. M., Artigue, M., &Noss, R. (2009). Building European collaboration in technology-enhanced learning in mathematics. In Technology-Enhanced Learning (pp. 73-87). Springer, Dordrecht.
4. Carvalho, A. (2015). National Report on Education and Technology: South Africa. http://ifip-education.ning.com/page/national-reports-on-education-and-technology. Accessed 1 July 2015.
5. Dagiené, V. (2015). National Report on Education and Technology: Lithuania. http://ifip-education.ning.com/page/national-reports-on-education-and-technology. Accessed 1 July 20157.
6. EDUsmmIT (2015). TWG 9: Curriculum - Advancing understanding of the roles of CS/Informatics in the Curriculum: Research Plan. http://www.curtin.edu.au/edusummit/local/docs/twg9-research-plan.pdf. Accessed 27 December 2015.8.
7. Grandbastien, M. (2015). National Report on Education and Technology: France. http://ifip-education.ning.com/page/national-reports-on-education-and-technology. Accessed 1 July 20159.

a. http://ifip-education.ning.com/page/national-reports-on-education-and-technology. Accessed 1 July 2015.16.

8. Kimn, H.J. (2015). National Report on Education and Technology: Republic of Korea. http://ifip-education. ning.com/page/national-reports-on-education-and-technology. Accessed 1 July 2015.17.
9. Koivisto, J. (2015). National Report on Education and Technology: Finland. http://ifip-education.ning.com/page/national-reports-on-education-and-technology. Accessed 1 July 2015.
10. Leahy, D. (2015). National Report on Education and Technology: Ireland. http://ifip-education.ning.com/page/national-reports-on-education-and-

technology. Accessed 1 July 2015.
11. Lents, N. H., & Cifuentes, O. E. (2009). Web-based learning enhancements: Video lectures through voice-over PowerPoint in a Majors-level Biology course. Journal of College Science Teaching, 39(2)..
12. Lo, C. K., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. Research and practice in technology enhanced learning, 12(1), 4..
13. Marks, D. B. (2015). Flipping the classroom: Turning an instructional methods course upside down. Journal of College Teaching & Learning, 12(4), 241-248.
14. Passey, D. (2015). Computer science (CS) or information and communication technologies (ICT): the curriculum needs both. IFIP.
15. Passey, D. (2017). Computer science (CS) in the compulsory education curriculum: Implications for future research. Education and Information Technologies, 22(2), 421-443.
16. Ronchetti, M. (2010). Using video lectures to make teaching more interactive. International Journal of Emerging Technologies in Learning (iJET), 5(2), 45-48.
17. Ryback, D., & Sanders, J. J. (1980). Humanistic versus traditional teaching styles and student satisfaction. Journal of Humanistic Psychology, 20(1), 87-90.
18. Saito, T. (2015). National Report on Education and Technology: Japan.
19. Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. Learning environments research, 15(2), 171-193.
20. U3A Online. (2015). U3A Online. http://www.u3aonline.org.au/. Accessed 5 January 2015.
21. UCISA. (2010). Survey of Technology Enhanced Learning for higher education in the UK. http://www.ucisa.ac.uk/groups/ssg/~/media/groups/ssg/surveys/TEL%20survey%202010_FINAL.ashx. Accessed 29 June 2015.
22. UCISA. (2012). Survey of Technology Enhanced Learning for higher education in the UK. https://www.ucisa.ac.uk/~/media/groups/ssg/surveys/TEL_survey_2012_with%20Apps_final.ashx. Accessed 29 June 2015.
23. UCISA. (2014). Survey of Technology Enhanced Learning for higher education in the UK. https://www.ucisa.ac.uk/~/media/groups/dsdg/TEL%20Survey%202014_29Sep2014.ashx. Accessed 29 June 2015.
24. UK Digital Skills Taskforce. (2014). Digital Skills for Tomorrow's World. http://www.ukdigitalskills.com/wpcontent/uploads/2014/07/Binder7-REDUCED2.pdf. Accessed 9 October 2015.
25. Van Niekerk, J. (2015). National Report on Education and Technology: South Africa. http://ifip-education.ning.com/page/national-reports-on-education-and-technology. Accessed 1 July 2015.
26. Voogt, J., Fisser, P., Good, J., Mishra, P., & Yadav, A. (2015). Computational thinking in compulsory education: Towards an agenda for research and practice. Education and Information Technologies, 20(4), 715-728.