

Facilitating Portfolio for holistic Engineering Education: An alternative Perspective

Dr.K.Rajeswari & Dr.G.Ananthi

Department of ECE, Thiagarajar College of Engineering, Madurai – 15

Abstract— Portfolios provide evidence of facilitation from various sources in terms of student ratings context. It is the process of selecting and organizing material for a portfolio that can reflect facilitation. Facilitating portfolio capture facilitating career that can be called as facilitating portfolios that capture evidence related to the course. Using portfolios, facilitators can share in virtual mode and invite their comments from peers to share facilitating successes and accordingly build their careers. The components of facilitating portfolio are facilitating statement, documentation, effectiveness, demonstration of student learning using materials, activities, contribution to the Institution and recognition. The facilitating portfolio contains student's reflection in terms of context, knowledge and growth. The advantage of preparing this facilitation portfolio is to engage the students in an active manner. It deals with bringing the students to the classroom. This portfolio is useful for developing student knowledge in an effective manner. The facilitator can address the problems of students through preparedness in the curriculum. It also deals with curriculum structure and provides sufficient support for students. The curriculum structure and facilitation techniques can be used to develop social framework inside the classroom. The facilitation process is affected by means of the contextual issues arises from professional, Institutional, student body, national and international agencies. This portfolio is useful for developing the student knowledge. The technology has been used for the improvement of student experience and enables better understanding of core concepts. This paper deals with the implementation of facilitating portfolio for the curriculum and student learning through activities.

Keywords— Active learning Strategies; Course Outcome; Curriculum Structure; Facilitating Portfolio; Student learning.

JEET Category—Practice

I. INTRODUCTION

Facilitating portfolio is one of the representations of the facilitator identity. This portfolio conveys the message using the facilitation techniques and creates evidence. In early days, writing portfolios are popular. Students can learn writing themselves by means of repeated imitation from sample texts to make creativity. This method is suitable only when educational resources are scarce in terms of large class size, lag in the facilitation and give restricted access for authentication that leads to active thinking and originality.

This technique is dealt with rule bound, text based and process-oriented method for writing (Grabe & Kaplan, 1996). The process writing has been assessed for its anarchism and it has an inability to prepare students to connect the discourse community (Hamp-Lyons, 2006). The facilitators follow genre-based pedagogy which provides the relationship between readers,

texts and writers. The grammatical features of these genres provide meaningful communications in terms of complaint letter to provide compensation.

The portfolio facilitation instructional genre-based pedagogy practices motivate the students to improve their writing skills. The portfolio assessment consists of process of writing explained by K. Hyland & F. Hyland (2006) involves group of ideas useful for writing and logical handling for the improvement of student's cognitive thinking skills. This facilitation is useful to monitor the students' learning skills. This process is also useful to motivate the students to increase the self-regulated learning capacity skills. The process writing can be improved using facilitators' resources and also from peers in a collaborative environment (Hamp-Lyons, 2007). The process writing is the facilitating recursive skill which facilitates editing, revising and drafting.

The portfolio facilitation provides maximum level cognitive thinking skills for the students in terms of assessment. This portfolio assessment is dealt using genre approach, since some portfolios use academic genres based on the curriculum. The portfolio assessment includes collaborative learning, cognitivism and socio constructivism (Norwell, Hamp-Lyons & Condon, 1993).

Collaborative learning tool is used to facilitate students learning skills by encouraging facilitators, students and parents. The class room-based assessment tools are teacher assessment, self and peer assessment which are important for core learning. Socio constructivism portfolio involves reflection, self-assessment, selection, evaluation delay, collection and student centric development process (Hamp-Lyons & Condon, 2000). The method of tests in writing is direct testing, indirect testing, portfolio facilitation and assessment (Hung, 2009). The performance assessment is to test students writing ability by facilitators in the class room (Huot, 2002).

The students can update case studies and examples for their courses to improve the curriculum content to meet the objectives of the courses (Barbara, Susan Kahn, Daniel, Kathleen Blake Yancey, 2011). Students seek a new material to modify and supplement the courses from the curriculum. The curriculum syllabus includes course descriptions, learning outcomes, academic requirements and expectations regarding course structures, examinations, papers and graded rubrics. Required and recommended topics are identified and included in the curriculum. The course syllabus is updated based on the style of facilitation and student feedbacks. The documents of student learning outcomes provide descriptions and reflective analysis of student progress in stages, demonstrates the relationship between facilitation and student learning (Hutchings, 1998). The paper is organized as follows. Section II explains strategies adopted to improve the syllabus and learning outcome of the students. Section III describes active learning strategies implemented and their reflection on students. Outcome of the experimentation is

summarized in section V. Section VI concludes the paper.

II. IDENTIFICATION OF STRATEGIES

A. Improved Framework of Syllabus

Initially, the course 'Analog and Digital Communication' with code 14EC540 had the following components: Preamble, prerequisite, course outcomes, mapping with programme outcomes, assessment pattern, course level assessment questions, concept map, syllabus, text book, reference books, course contents and lecture schedule and course designers. Later the components 'CO mapping with CDIO curriculum framework and assessment pattern: psychomotor' (CDIO stands for Conceive-Design-Implement-Operate) were included facilitating the use of different active learning strategies and assessment strategies to be adapted to improve students' performance. CDIO framework facilitates the design of syllabus to define the outcomes of the course in terms of learning objectives. It defines initiatives to improve student learning and provides suitable assessment process. Currently, the components of syllabus are as follows: Preamble, prerequisite, course outcomes (Fig.1), CO mapping with CDIO curriculum framework (Fig.2), mapping with programme outcomes and programme specific outcomes, assessment pattern: cognitive domain, assessment pattern (Fig.3), psychomotor, sample questions for course outcome assessment, concept map, syllabus, learning resources, course contents, lecture schedule and course designers.

| Prerequisite | | |
|---|--|----------------|
| 14EC340 Signals and Systems, 14EC440 Signal Processing | | |
| Course Outcomes | | |
| On the successful completion of the course students will be able to | | |
| CO# | Course Outcome Statement | Weightage in % |
| CO1 | Characterize the different analog modulation schemes in time and frequency domains. | 10 |
| CO2 | Analyze the performance of analog modulation schemes in the presence of additive white Gaussian noise. | 10 |
| CO3 | Describe the principle of pulse modulation techniques namely PAM, PPM, PCM, DPCM and DM. | 10 |
| CO4 | Determine the minimum number of bits per symbol required to represent the source and the maximum rate at which reliable communication can take place over the channel. | 20 |
| CO5 | Detect and correct the errors introduced in the channel using error control coding schemes. | 15 |
| CO6 | Design the baseband pulse for ISI free transmission over finite bandwidth channels. | 10 |
| CO7 | Apply estimation and detection theory for the development of digital communication transmitters and receivers for various digital modulation schemes and analyze their BER performances. | 25 |

Fig.1. Prerequisite and Course Outcome of the Course 'Analog and Digital Communication Systems'.

| CO Mapping with CDIO Curriculum Framework | | | | | |
|---|-----------------------|-----------------------|-----------|-------------------------|---|
| CO # | TCE Proficiency Scale | Learning Domain Level | | | CDIO Curricular Components (X,Y,Z) |
| | | Cognitive | Affective | Psychomotor | |
| CO1 | TPS3 | Apply | Value | Mechanism | 1.2, 2.1.1, 2.1.2, 2.4.2, 2.4.5, 2.4.6, 3.1.1, 3.2.3, 4.5.5, 4.6.2 |
| CO2 | TPS4 | Analyze | Organise | Complex Overt Responses | 1.2, 2.1.1, 2.1.2, 2.4.2, 2.4.5, 3.1.1, 3.2.3, 4.5.3, 4.5.5, 4.6.2 |
| CO3 | TPS3 | Apply | Value | Mechanism | 1.2, 2.1.1, 2.1.2, 2.4.2, 2.4.5, 2.5.1, 3.2.3 |
| CO4 | TPS3 | Apply | Value | Mechanism | 1.2, 2.1.1, 2.1.2, 2.1.4, 2.4.2, 2.4.5, 4.4.1, 4.4.3 |
| CO5 | TPS3 | Apply | Value | Mechanism | 1.2, 2.1.1, 2.1.2, 2.1.4, 2.4.2, 2.4.5, 4.4.1, 4.4.3 |
| CO6 | TPS3 | Apply | Value | Mechanism | 1.2, 2.1.1, 2.1.2, 2.1.4, 2.1.5, 2.4.2, 2.4.5, 4.4.3 |
| CO7 | TPS4 | Analyze | Organise | Complex Overt Responses | 1.2, 2.1.1, 2.1.2, 2.1.4, 2.1.5, 2.4.2, 2.4.5, 2.5.1, 3.2.5, 4.4.3, 4.5.3, 4.5.5, 4.6.2 |

Fig.2 CO Mapping with CDIO Curriculum Framework of the course 'Analog and Digital Communication Systems'

| Assessment Pattern: Cognitive Domain | | | | | | | |
|--------------------------------------|-----------------------------|----|----|------------|----|----|--------------------------|
| Cognitive Levels | Continuous Assessment Tests | | | Assignment | | | End Semester Examination |
| | 1 | 2 | 3 | 1 | 2 | 3 | |
| Remember | 10 | 10 | 10 | 0 | 0 | 0 | 10 |
| Understand | 10 | 10 | 20 | 0 | 0 | 0 | 10 |
| Apply | 80 | 60 | 60 | 100 | 70 | 50 | 60 |
| Analyse | 0 | 20 | 20 | 0 | 0 | 20 | 20 |
| Evaluate | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Assessment Pattern: Psychomotor | | | |
|---------------------------------|--------------|--------------|--------------|
| Psychomotor Skill | Assignment-1 | Assignment-2 | Assignment-3 |
| Perception | - | - | - |
| Set | - | - | - |
| Guided Response | - | - | - |
| Mechanism | - | 30 | 30 |
| Complex Overt Responses | - | - | - |
| Adaptation | - | - | - |
| Origination | - | - | - |

Fig.3 Assessment Pattern in Cognitive Domain and Psychomotor Domain in the course 'Analog and Digital Communication Systems'

B. Active Learning Strategies

Number of active learning strategies are available to make the students to listen and learn efficiently. Few of them are: think-pair-share, brainstorming, one minute paper, animation, concept test, discussion forum, quiz at the end of topic/class through pear deck and menti.com, peer instruction, cluster-based learning and group problem solving. Learning teams are identified to work for group assignments.

Some of the active learning strategies are explained here. In think-pair-share activity, when the teacher asks the questions, students have been given one or two minutes to think. Then they are allowed to share their answers with peers and answer the questions. In one-minute paper activity, students are asked to write their understanding of the topic taught in a minute which forms feedback for the teacher.

Cluster based learning is useful to move the students from LOTS (Low Order Thinking Skills) to HOTS (Higher Order Thinking Skills). Clusters of videos are used. First, the student watches a video and answers questions that provokes LOTS. If the answers are up to the mark, the student is allowed to watch the next video on HOTS. The next section includes explanation of other active learning strategies and their implementation and reflection.

II. IMPLEMENTATION AND ITS REFLECTION

A. Reflection on Students

The reflection on students is the type of service-oriented learning experience for the academic activities applying critical thinking skill of the students. Examples of reflection activities are group discussions, videos and worksheets. Fig.4 shows the sample worksheet shared with students for the subject 'Analog and Digital Communication Systems'. Students are able to have a chance of practice based on their mindsets. Facilitators can work with a student for their performance. In assessment reflection, students explained their studies to the facilitators. The facilitators can try other tools such as practice tests and asking questions. The process is continued till the students get good score in their test. Fig. 5.a shows the result of concept test conducted in the class.

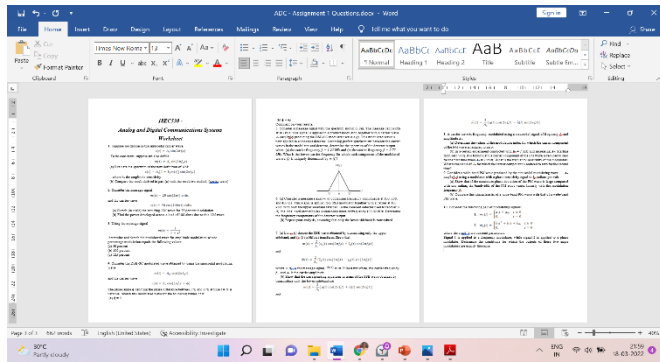


Fig.4. Sample Worksheet

Few students have got full mark and they gave positive feedback for the concept test. Fig.5.b shows the increased number of students participation over the time.

| Student ID | Student Name | Status | 2020 6:00 PM | 2020 6:23 PM | 25 secs | Score | Feedback |
|-------------------------|------------------------------|----------|--------------|--------------|---------|-------|----------|
| 61457 K | bharathkumar@student.tce.edu | Finished | 2020 6:00 PM | 2020 6:23 PM | 25 secs | 10.00 | ✓ 1.00 |
| 61469 MUTHULAKSHMI | muthulakshmi@student.tce.edu | Finished | 2020 6:00 PM | 2020 6:29 PM | 29 secs | 7.00 | ✓ 1.00 |
| 61436 Jegan P | jegamp@student.tce.edu | Finished | 2020 6:00 PM | 2020 6:24 PM | 24 secs | 9.00 | ✓ 1.00 |
| 61514 Sulaaha Nasrin, A | sulaaha@student.tce.edu | Finished | 2020 6:00 PM | 2020 6:24 PM | 49 secs | 4.00 | ✗ 0.00 |

Fig.5. a. Concept test in a class

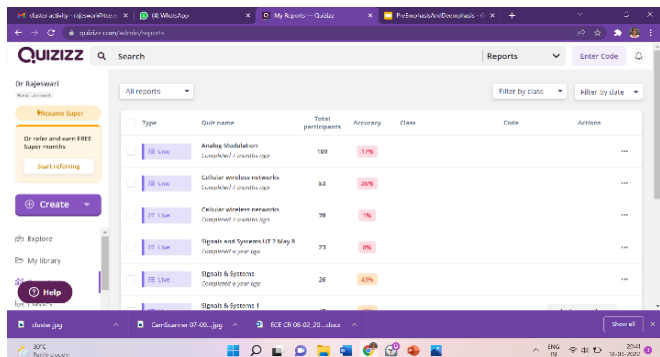


Fig.5.b. Quiz in a class

B. Reflection on context

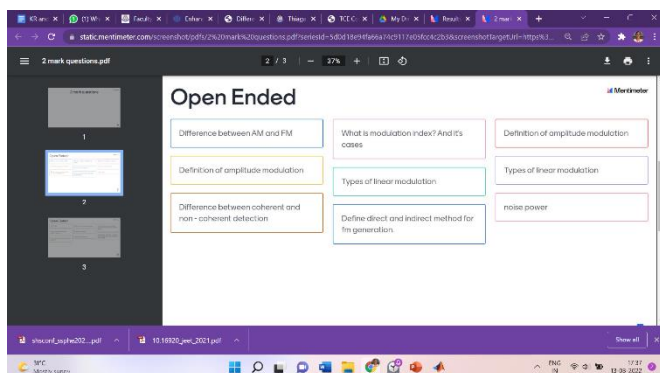


Fig.6 a. Discussion through Menti.com

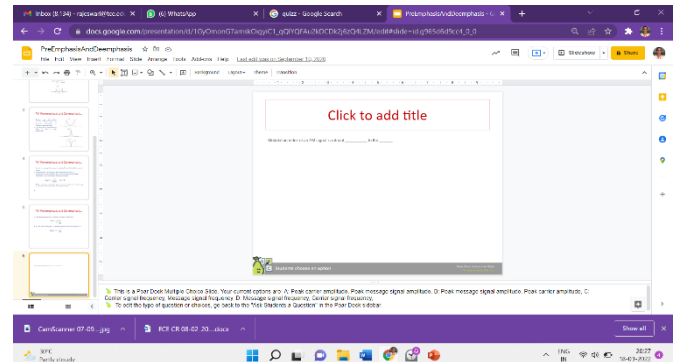


Fig.6. b. Q & A through Pear Deck

The reflection on context interprets how well students understand the concepts, gather knowledge and improve their grasping power. Facilitators can continuously monitor the student's activities and transfer the knowledge through various activities. Fig. 6.a & 6.b show the discussion conducted through menti.com and Q & A session conducted through pear deck in class hours once in 20 minutes in the class h. The discussion and answers to Q&A ensures whether the students understand the context of the topic taught.

C. Reflection on Knowledge

The students' knowledge reflection can be seen through projects, assignments, course outcomes and student peers. The advantage of student's reflection on knowledge is used to transform student's implicit knowledge to explicit knowledge. The student's experiences have been shared and are transformed to practice. Fig. 7 shows the discussion forum used to share the students' reflections on the works assigned for them and to share the future trends of the course.

D. Feedback from students

Students interacted with other students and they motivated themselves to understand the concepts better. Assignments'

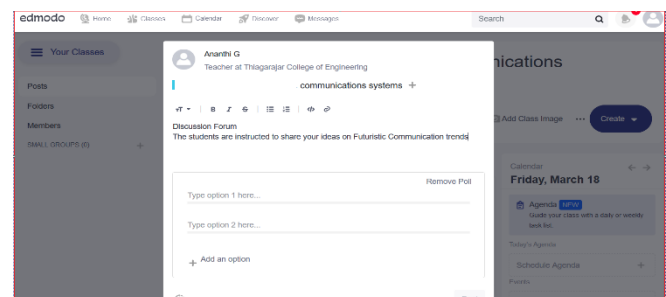


Fig. 7. Discussion Forum

reflections are useful for the students in terms of how theory will help them to implement practices through sharing the techniques used among their class mates. Fig. 8.a. shows the presentation of assignment problems in a class by students. Each group of students is assigned with different problems. The presentation facilitates familiarity of all the problems for all the students. Fig. 8.b shows presentation on future communication by a student group.

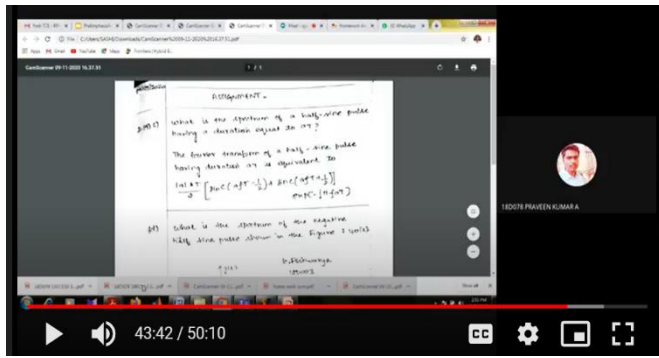


Fig.8. a. Students' presentation of assignment problems

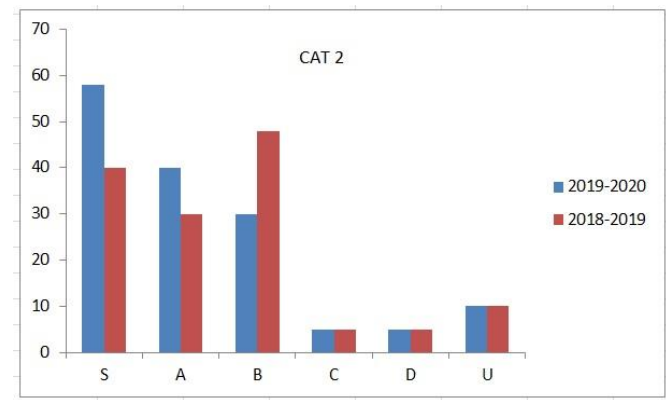


Fig.9.b CAT-2 Performances in the year 2018-19 and 2019-20



Fig.8. b. Students' presentation on future communication

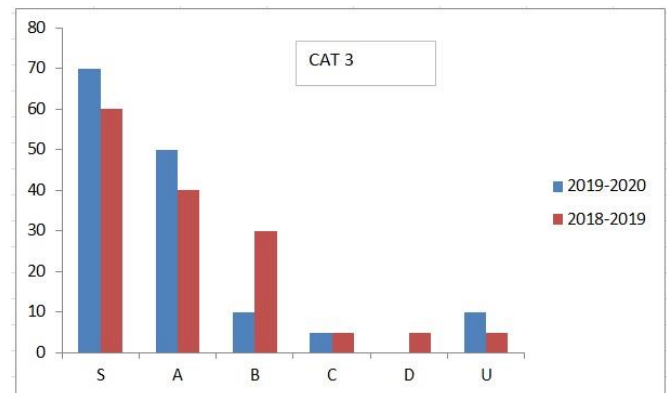


Fig.9.c.CAT-3 Performances in the year 2018-19 and 2019-20

E. Reflection on Growth

In addition to teaching, teachers as facilitator expand the students' knowledge, develop the academics and help the students to improve positive social skills. The facilitators build the positive relationship for the students to improve their skills and contribute to their academic and non-academic growth.

III. IMPACT ON TEST PERFORMANCE AND PROFICIENCY

The outcome of the process is clearly seen in the result of continuous assessment tests (CAT). Fig.9 shows the comparison of students' performance in CAT-1. Total students' strength is 140 in both years. In the result, mapping between marks and grades are: S- 90 and above, A- 80 and above, B-70 and above, C-60 and above, D-50 and above and U-Fail. Number of students who got S grades and A grades in

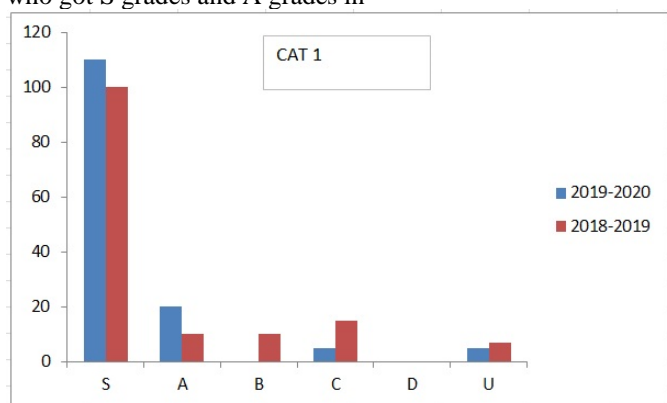


Fig.9.a CAT-1 Performances in the year 2018-19 and 2019-20

the assessment year (2019-20) is more compared to the previous year (2018-19). In addition, number of failures is also decreased. From figure 9.b and 9.c, it is observed that in CAT-2 and CAT-3 also, number of students who got S grades and A grades is increased. Fig.10 shows the inferential statistics of the grades received by the students in three CATs for the years

| CAT-1 | | | | | |
|---------|-------|----|--------|-------|----------|
| Source | SS | df | MS | F | Prob>F |
| Columns | 16195 | 5 | 3239 | 96.21 | 1.21e-05 |
| Error | 202 | 6 | 33.667 | | |
| Total | 16397 | 11 | | | |

| CAT-2 | | | | | |
|---------|---------|----|---------|-------|--------|
| Source | SS | df | MS | F | Prob>F |
| Columns | 3777.67 | 5 | 755.533 | 12.12 | 0.0043 |
| Error | 374 | 6 | 62.333 | | |
| Total | 4151.67 | 11 | | | |

| CAT-3 | | | | | |
|---------|---------|----|---------|-------|--------|
| Source | SS | df | MS | F | Prob>F |
| Columns | 6466.67 | 5 | 1293.33 | 23.88 | 0.0007 |
| Error | 325 | 6 | 54.17 | | |
| Total | 6791.67 | 11 | | | |

Fig. 10 Inferential statistics of grades of students in three CATs

2018-2019 and 2019-2020. Since p value is less than 0.01, the null hypothesis is rejected and there is significant difference in grades

obtained after the adaptation of facilitating portfolio (Prasanth M. K., Suresh Kumar N., Ajith Sundaram (2012), Erin Shore, Patricia C. Cheung, Eric Hyde, Julie A. Gazmararian (2019)). As a result, actual proficiency at the course outcome level has become greater than expected proficiency levels for each course outcome which

TABLE I.
ACTUAL AND EXPECTED PROFICIENCY LEVEL

| Course outcomes | Expected Proficiency (Course Outcome level) | Actual Proficiency (Course Outcome level) |
|-----------------|---|---|
| CO1 | 80 | 87.54 |
| CO2 | 80 | 85.75 |
| CO3 | 80 | 86.44 |
| CO4 | 80 | 84.08 |
| CO5 | 80 | 84.44 |
| CO6 | 80 | 84.28 |
| CO7 | 80 | 84.45 |

were set at the beginning of the course. Table I shows the actual and expected proficiency at the course outcome level for the chosen course. Expected proficiency levels at the course outcome level are set based on the performance of the students in this course in the previous three years.

IV. CONCLUSION

This experimental work is to develop portfolio for the course 'Analog and Digital Communication Systems' to improve the learning outcome of the students. The syllabus is reframed to meet CDIO requirement which inherits the way for providing facilitating statement and documentation. The active learning strategies such as quiz through pear deck, concept test, team-based seminars and problem solving and implementation of LOTS to HOTS had a great impact on interest of students towards the subject. The challenges faced during implementation is completion of syllabus. The presentation of this experimental work in 'Faculty Conclave' conducted in the institution provided us the platform for sharing this work among our peer faculty. The outcome of the experimental work is seen through the increased students' performance in continuous assessment test. The proficiency levels achieved in each course outcome is higher than the expected course outcome level set which is decided based on previous year results. Now, clear plan is available for the course 'Analog and Digital Communication' in terms of topics, organized material and activity to be carried out for each topic to improve students' interest and test performance. This will have a great impact on students to move towards core company placement

like Qualcomm and Analog Devices.

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K. Rajeswari (Senior Member, IEEE) received the Ph.D. degree in wireless communication from Anna University, Chennai, Tamil Nadu, India in 2015. She has a working experience as a Lecturer for 11 years and as an Assistant Professor for 12 years. She is currently an Associate Professor with the Department of Electronics and Communication

Engineering, Thiagarajar College of Engineering, Madurai. She has published research papers in reputed journals like IEEE sensors and published in 20 conferences. Also, she acts as a reviewer for reputed journals like IET Electronics Letters.. She has received best paper award for the paper published in IEEE International Conference on Computational Intelligence and Computing Research. Her research interests include digital signal processing, MIMO-OFDM wireless communication, and biomedical signal processing. She is part of content developer for the MOOC course 'Discrete Time Signal Processing'. She is a Senior Member in IEEE and Member in IE and ISTE.



Dr.G.Ananthi is an Assistant Professor with a Department of Electronics and Commun. Engineering, Thiagarajar College of Engineering, Madurai, India. She has published Fourteen International Journal papers and twenty-eight research papers in National and International conferences. She

received Proficiency award from Quality Circle of Forum of India. She secured first rank in M.E (Applied Electronics) from Anna University, Chennai. She published three book chapters in Springer, Wiley and IGI Global Publishers. Her Research interests include in physical layer aspects of wireless communication systems, Deep learning algorithms and Vehicular Networks. She is working in Eye disease findings using Deep learning algorithms along with Aravind Eye Hospital, Madurai. She is guiding three Ph.D Students in the area of Vehicular Networks and Energy harvesting under Anna University, Chennai. She is a Senior Member in IEEE, Member in IET, IETE and ISTE. She is a IEEE Student Branch counsellor of Thiagarajar College of Engineering, Madurai. She organized various IEEE Workshops, events and proctored in IEEE Xtreme contests. She attended many conferences, seminars and acted as a session chair in various conferences. Also, she conducted faculty development programs and workshops at TCE. She has 21 years of professional practice in the areas of wireless communications, energy harvesting, signal processing, vehicular networks and deep learning area. She received best paper award for the IEEE International Conference on Secure Cyber Computing and Communications, NIT, Jalandhar.