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An Empirical Vision for Inspiring Students as a Core Driver to meet Global Challenges

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Abstract: Students of Malnad College of Engineering, Hassan should be delighted to say "we are the creation of M.C.E". For this, we professors should put in effort to bring transformations in engineering education. It is intended to illuminate modern best practices in order to inform, enhance and promote beneficial learning skills & attributes among the undergraduate students. This motivated to adopt various modes to transform the teaching methodology in the course "Digital Principles and Applications". It is an attempt to make students realize the course with practical approach. The milestone started right from framing the syllabus with the aid of Industry experts. The methods discussed were adopted and found success. We also grabbed the ideas from faculty of Electrical and Electronics Engineering to come out with hardware projects. Students articulated their contentment about the knowledge achieved with practical approach and involvement that resulted in better understanding of the concepts.

Keywords: PEER Evaluation, Self - Study Component, Project Exposition

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1. Introduction

IT industry is in need of graduands with strong fundamental concepts to excel in the IT world. It requires graduates with enhanced skills who can think creatively and be innovative in a global economic environment.In order to surpass as an IT professional, the graduands should be well-built with the fundamental concepts. It always creates a gap, if students' do not have practical exposure. The approach adopted in the course is to bridge this gap and create application capability in the graduands.

Methods adapted for teaching the course was an assortment of power point presentations, assignments, self-study component, group discussions, quizzes etc.

The conglomeration of all these resulted with a mini project which helped in the overall development of the students.

It teaches the fundamental principles of digital systems and covers thoroughly both traditional and modern methods of applying digital design and development techniques, including how to manage a systems level project. Rather than sticking to the content based education, we have emphasized more on ensuring that the student has learnt the real time application of the content. This is accomplished by rendering practical skills that a student requires to develop while learning. A process of empowering the students to assess the knowledge accurately has been

initiated. By this, they become efficient and confident learners.

In industry today, we see the importance of getting a product to market very quickly. The use of modern design tools allows engineers to progress from concept to functional silicon very quickly.

The course "Digital Principles and Applications" is included as a core subject for 2nd year Information Science and Engineering students. It is taught with 4 hours of teaching and 6 hours of practical session per week (two batches of three hours). Students should gain the in-depth knowledge of deciding the suitability of a particular digital design for a given application. This requires a sound understanding of the fundamental concepts.

To achieve this, many effective teaching methods were used. The well-known VHDL programming was used for simulation of the design. Concepts are further elaborated by taking real life examples which help students to apply this knowledge in developing various kinds of applications.This makes students well versed in understanding the theoretical concepts. Students are directed to take the aid of faculty in Electrical and Electronics Engineering during their project work. Assessment is done by conducting written tests, online quiz, individual assignment, team assignment, presentations and mini projects.

This paper is divided into 5 sections. The next section gives a review of related works and the ideas applied ahead. Ulterior sections, viz. Section 3 elucidate about the milestones of the course. Section 4 depicts the impact of the course and concluding remarks are made in Section 5.

2. Related work

According to Richard M.Felder "A class in which students are always passive is a class in which neither the active experiments nor the reflective observer can learn effectively. Unfortunately, most engineering classes fall into this category". Creating interest and making students interactive in class room teaching is a challenge for any teacher. With-holding the concentration of a student is an art that a teacher should develop. Teaching is a very respectable practice which enriches the students' lives. But making students become creative thinkers and problem solvers is an achievement both for the students and for the teacher. Teaching has to be systematic, informative and comprehensive. Teaching has taken different flavours during the recent years.

The drawbacks of traditional teaching method which is teacher-centred and relies on black board and chalk can be summarized as:

1) Lacks Student Focused Learning: More emphasis will be on standards, curriculum and passing tests as opposed to student-focused learning. Student-focused learning places value on the student and builds the curriculum around the questions young people need to answer in order to understand the material. Constructivist learning builds on the knowledge students already have allowing them to form concrete associations to new information, which improves retention. Traditional learning is based on repetition and memorization of facts that students care less about and retain at lower rates after testing.

2) Lacks Emphasis on Critical Thinking: Traditional classroom training doesn't encourage critical thinking skills, the ability to actively apply information gained through experience and reasoning. Instead, traditional training emphasizes the role of teachers as knowledge dispensers and students as repositories. This style of learning doesn't allow student's deeper levels of understanding required for complex concepts and lifelong learning.

3) Incomplete practical knowledge: During regular labsessions, students solve the given assignments using the simple data structures taught in the class. But, they will not be able to judge as to which data structure to use for what sort of problems when need to solve for huge data in real time applications.

4) Lacks Interactivity: Traditional training emphasizes individual student work which leads to poor preparation of student for his/her future endeavours. As working in teams and collaborating with colleagues is the need of any profession, students receive few opportunities to practice group dynamics under this training model.

Over the past few decades, people have been experimenting various strategies to enhance the quality of teaching in engineering education. Ditcher [1] has stressed upon the reasons and the need to change engineering education. Problem-based learning as an alternative to traditional learning has been highlighted. Survey results in [5] show the use of various visualization tools like DSL, TRAKLA2,

VIDSAA, EDM and AETA which inspired us to think about the use and development of new tools for teaching data structures. Blended learning was applied by Xiaojing et al. [7] which is a combination of various teaching methods, project-based teaching, E-learning, course experiment and design, process evaluation and overall evaluation. The authors found that the blended learning model provides more effective and efficient educational experience than traditional teaching method.Hence, to shift students from the traditional learning, where they simply receive knowledge, we have formulated an approach where they become actively involved developing new ways of understanding the subject through participation.

Rather than having students learn facts that they might need someday, we thought it would be better to put them to collaborative learning environments where group of students find solution to real world scenario [4].

Project based learning approaches have served students to develop constructive learning instead of having the objectivist view about the facts and concepts [2-3].

3. Milestones of the Course

The proposed attempt was to strengthen the fundamental concepts of digital world which is the base for IT students.

"Digital Principles and Applications" course was chosen as an experiment. The course was organized for 52 hours of theory and 96 hours of practical sessions in a semester. Both the teachers and students were benefitted in updating themselves. Teachers experienced the way a course should be taught in an effective manner and students improved their listening skills along with the practical approach since there were quizzes in between the sessions.

1) Constitution of the program

The entire program is divided into different phases as shown in Figure 1.In the first session, overview of the course with abstract definition is introduced to the students to get an idea of their learning's in this course in the whole semester. Visual aids and multimedia contribute positively to the pedagogical value of in-class education, so simulation tools and animations are used to demonstrate the concepts. MultiSim tool was used to provide the students an interactive platform and realise the functions of various gates and the circuits designed by them.

Simulation helps in reducing the cost for building the circuit because the circuit is designed only when it works fine during simulation. It also helps the students to understand the concepts practically. Fleming's VARK model states that 60-65% people are visual learners and thus learn best by using pictures and visual aids.

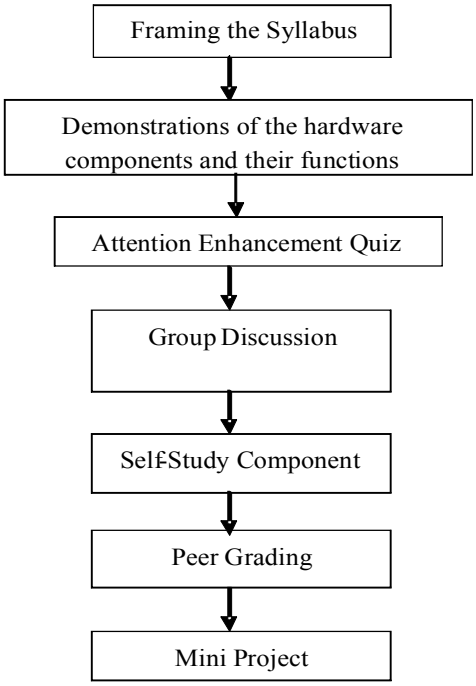


Fig. 1 Flow of the Entire Program

2) Framing the Syllabus

The first step for being successful in reaching the students and make them excel in IT world is framing an excellent and beneficiary syllabus. With the permission of our beloved Principal, we took the aid of Industry experts. Rather than inviting one or two experts from the industry, we, faculty as a team visited Infosys campus at Mysore. We had discussions with the heads of various departments at Infosys to know the industry needs since we are developing the products (Engineers) for them and they are the ultimate end users. We not only gathered information regarding the needs, we discussed about the methods they are adapting to train the fresher's. This will reduce the training period for the industry as we could train our students well before entering the industry as per industry requirements.

3) Demonstrations

In every session, wherever necessary, the demonstration of various gates and truth tables was given. This gave them the touch and feel of the components; also the awareness of the cost of the components was created and got familiar with the IC's. Any simple or complex problem becomes easier to understand by such demonstrations. The demonstration was followed by discussion where the students shared their experiences in developing the logic circuits. This further enhanced their confidence and also paved way to learn about the strategies adopted by others.

4) Attention Enhancement Quiz

In every session, students will have to answer few quiz questions on the topic delivered in the same session. This will make them to be alert in the class and in turn improve their listening skills.

Fig. 2 Meeting with Infosys Team

5) Group discussion

Apart from regular schedule, we would pick time for group discussion to share their ideas/thoughts about a particular topic. This helped to know among themselves personally and academically.

6) Self-Study Component

A simulation part at the end of each chapter i.e., about hardware description language (HDL) was taken as a self-study component. Students were supposed to give seminar for the same. This component was successful in building an environment where participation of every student was encouraged and it facilitated group learning.

7) PEER Grading

Assignments were given at the end of each chapter but it was not evaluated by the mentor at the first stage. It was evaluated by their peers at the first step, this will make them aware of different approaches thought by their contemporaries and make them to think in different perspective and also learn evaluation skills.

8) Mini project

Finally, the whole efforts of the semester lead to a mini project (Refer Fig. 3) with a batch of 4 students - The ultimate goal what they really enjoyed. We exhibited the projects, invited Principal and Subject experts for the exhibition where the efforts put forth by the students was appreciated.The mini projects developed the students' understanding of the operation of logic gates and created awareness within the field of study.

Some of the major projects are listed below:

- Simple touch alarm
- Mosquito repellent
- Forward and reverse led
- Clap switch
- Implementation of basic gates
- Burglar alarm
- Seven segment display
- Moving led bulb
- Fire alarm
- Periodic table of elements

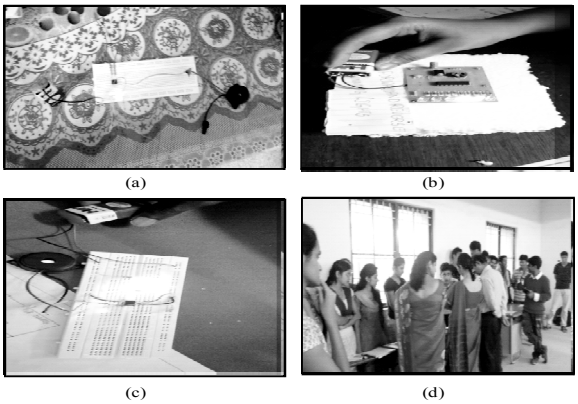
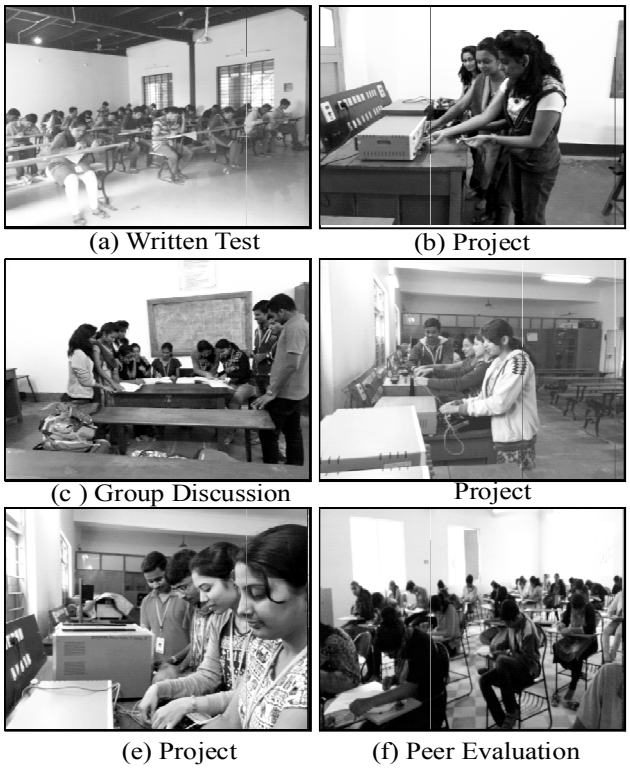


Fig.3 (a), (b) and (c) are the display of few projects developed (d) Project Exposition

Of course, teaching methodologies was a blend of presentation with slides, traditional chalk and talk wherever necessary, Group discussions, Peer Evaluation, Quizzes, Assignments, Self-study component and Seminars. After each unit, students were made to solve exemplar problems. For each of the task done by the students, grade points will be updated. Evaluation process was regular and was credited which was finally reflected in their transcripts. Sample images are given in Figure 4.



(a) Written Test (b) Project

(c) Group Discussion Project

(e) Project (f) Peer Evaluation

Fig. 4 Samples of various methodologies during the course.

The whole process not only enlightened the students about the course but also the mentor. It gave us good human relationship as a family which we are losing now-a-days.

4. Impact of the Course

The course "Digital Principles and Applications" was chosen as an experimental subject to create interest in students as it results with a hardware project with real time applications. Before coming out with a hardware project, they do simulate it using MultiSim tool. In the process, they learn to execute programs using VHDL/Verilog. Simulation helps them to improve their knowledge in circuit designing as it requires too many trial and error processes to obtain the desired output. In turn, it has reduced the cost by obtaining the final desired circuit without spending amount on hardware components.

The students appreciated the journey of the course involving various methodologies and also the current techniques and tools for teaching the course. They could realize the effectiveness of working in teams to accomplish a common goal.The program also had the positive effect of inducing research culture in students.

Feedback was collected to know the impact of the journey. The questionnaire included in the feedback and the response from students is tabulated in Table 1.

Table 1. Questionnaire and Their Responses

Criteria	Positive Response (In%)	Negative Response (In%)
Do you feel the framing of Syllabus helped you in getting the overall knowledge to result with real-time projects?	99	1
Do you feel the methodologies used in the course reached the unreached?	98	2
Do you feel the methods used will improve the technical and communication skills of students?	95	5
Did the methodologies meet your expectation?	98	2
Will you recommend the same to be adapted in other courses?	99	1

1) Feedback

Sample points of the feedback given by the students as extra comments on the milestones of the course:

- The mini project on digital principles and applications was a creative task for students. Emphasis was laid on application of theoretical knowledge on practical usage.
- It was a platform to learn to work as team; how to do extensive reading other than curriculum and also it was an initiative for the works and projects that the students have to carry out in further studies or as professionals.
- It is an initiative by the department for developing technical skills in students.

 It was a good experience and as students we look forward to have many such opportunities to improve our-self.

5. Conclusion

The idea of blending the methodologies of teaching to reach the students of different grades is a diminutive step towards improving the comprehension of the course. The methodologies adopted strengthened and increased their confidence and opened up a wider avenue to come out with more real time projects in near future. Students were capable of generating multiple ideas, concepts and solutions independently. The strategies used in the course were found to be helpful in capturing and sustaining the attention of the students thereby resulting in effective perceptual and conceptual learning. Further, this approach of teaching magnified the programming skills and simultaneously kept the students engaged through realistic projects thus making them globally fit where they can foster a fruitful culture of innovation. As a whole, the objective of bringing transformations in engineering education by adopting novel methodologies was achieved to a larger extent.

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