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Industry Relevant Curriculum Design in Engineering in India: A Case Study

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Abstract: Modernization of professional education to suit the industrial needs is a basic requirement of present times. In this paper, a case study of electrical engineering students in the present mode of education is presented. A survey has been done which shows the lacuna in the present system of education from the student's perspective.

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1. Introduction

Inflow of private investors has been one of the fundamental reasons behind improving the literacy rate in India and also facilitating the prospects of higher education for the Indians. Although there is a rise in literate candidates with professional education, employability of these candidates is a major issue that the country is facing. A highly populated country like India cannot provide job to all its engineers in the country. On the other hand, the professionals are not found to be equipped enough to be able to find themselves jobs in the global market. Revision of the present curriculum to make the students more equipped for industries will not only improve the employability of the budding engineers in the country but also internationally.

According to The Indian Express, a recent learning outcome assessment of undergraduate engineering students conducted by Stanford University and the World Bank has found that the overall higher order thinking skills of Indian students are "substantially lower" than the Chinese and Russians. The survey - conducted last year - had a respondent base of roughly 5,000 first-year and third-year B.Tech students from 200 randomly-selected public and private engineering institutes, not including the IITs. Similar learning assessments were conducted for engineering students in China and Russia. The daily added that this is the preliminary finding, part of the Technical Education Quality Improvement Programme (TEQIP) supported by the World Bank, and that a detailed report will be presented formally to the HRD Ministry this week.

In order to overcome the problem, many academicians and researchers have suggested various solutions in terms of changing the teaching methodology. Metri et al. [1] have discussed project-based learning approach for the micro-controller and micro-processor system design. Anil Kumar et al. [2] have used a group discussion approach to teach Digital Design through Verilog. Lydia et. al. [3] have suggest a combination of methodologies to substitute the traditional method so that the students obtain a better understanding of the subject.

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The major goal of any professional education is to make the students apt of industrial jobs and entrepreneurships. The traditional form of passive education cannot fulfill the goal. The students are required to have not only a theoretical knowledge of the technical side but also a practical experience of the actual model. Also, they be well equipped with time management and other managerial skills to be successful professionals and entrepreneurs. The traditional class work and laboratory model does not give the students enough scope for the students to experiment with their ideas. The new methods of learning include-

1. Project-based learning- Where the students are made to understand concept through small projects.

2. Think Pair Share- The students are asked to think about a given problem, then they can discuss ideas with their partners or in a group.

3. Flipped Classroom- Where the students actively come up with their ideas which are discussed on an open platform.

4. Problem Based Learning- It is an instructional method of hands-on, active learning centered on the investigation of messy, real-world problems. The students are introduced to the real-time obstacles, that arise in the society, this would increase their societal problem handling skills.

5. Visual Based Learning- A human brain stores any sort of information for much longer, when it visualizes it instead of grasping it aurally.

6. Logical Based Learning- The students should be given or shown any hypothetical situation and should be ask to solve them with logical thinking and reasoning.

Different methods may be chosen for various courses, depending upon their suitability. In this paper, an integrated approach of learning was implemented for the Electrical and Electronics engineering students. It has been implemented on final year EEE students for the subject High Voltage DC Transmission System. The method was also implemented for III EEE students for utilization of power.

2. Graduate Attributes

These are set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level. The GAs are examples of the attributes expected of a graduate form an accredited programme. The Graduate Attributes of the NBA are as follows:

1. Engineering Knowledge: Apply the knowledge of the mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identity, formulate, research literature, and analyse complex engineering problem reaching substantiated conclusions using first principle of mathematics, natural sciences, and engineering sciences.

3. Design/Development of solutions: Designing solutions for complex engineering system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct Investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The Engineer and the society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and Sustainability: Understand the impact of the professional engineering solutions and environmental contexts, and the demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practise.

9. Individual and Team work: Function effectively as, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with engineering community and with society at large, such as being able to comprehend and write with effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-Long Learning: Recognize the need for, and the preparation and ability to engage in independent and life-long learning in the broadcast control of technological change.

From the above 12 attributes, only few of them are being introduced to students of this phase. Attributes like Engineering knowledge, Problem analysis are some among the 12 that the students are made to face while the rest are just in books.

An engineer in today's era need to have, all the above mentioned attributes and not only just two or three of them. The 2-3 attributes that they have been dealing from past years, will not be sufficient enough to secure a good job. The education system here only focuses on exams and the marks obtained but not on the extent of knowledge a student gains or should gain.

The system is not the same like, it was some 15 years ago, where knowledge was the sole priority, and when compared to the present system it seems to be a full-fledged commercial system which prioritizes for reputation among other colleges which shall be measured by the quantity of marks that a student benefits.

Without any practical approach there is no appreciation of the theoretical expertise. Because when coming to real life situations, an individual will be judged on how practical the individual's thinking is.

3. Experiment-I Design of HVDC Transmission

The students were given all the basic knowledge regarding the operation of a power electronic converter and its modes of operation. Then a task was given to them to design an HVDC system including all equipments that would be necessary for its operation. The following stages were undertaken:

STEP 1: The teacher then discussed the various aspects of basic concepts.

STEP 2: The students were asked to design a power electronic converter using MATLAB.

STEP 3: They were asked to first discuss their designs in pairs.

STEP 4: Groups of 8 students were made were they were asked to design an HVDC system based on their observations of the converter operation and suggest a final proposal on a chart paper.

STEP 5: At the end of the discussion, the instructor discussed with all the groups regarding their design and the reasons they opted for the design. A design for the HVDC converter was finalized by the instructor.

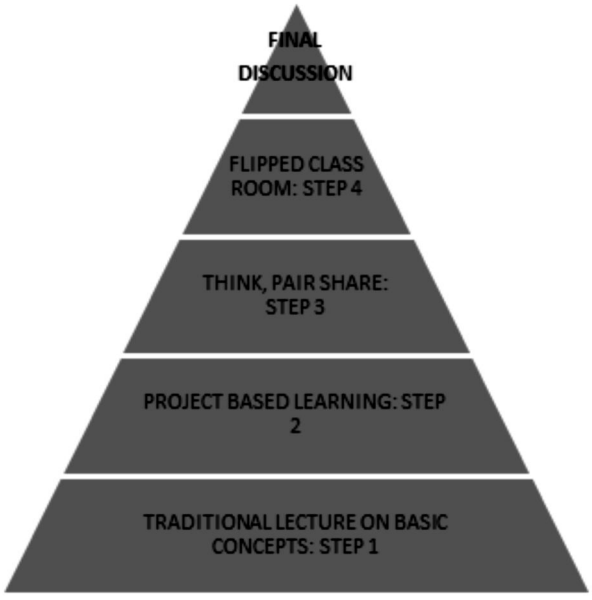

Fig.1 Integrated model of learning: a case study.

Experiment-II – Utilization of Power in the College Premises

The 2nd year electrical engineering students were asked to find out the electrical load demand of the college. They had to further analyze the percentage load contributed by different types of electrical load e.g. fan, lights, lab equipments, etc. Further the students had to give suggestions regarding how the load demand of the institute could be reduced. This helped the students understand the following concepts-

1. Understand the difference between the various electrical parameters namely, voltage, current and power.

2. Understand the importance of the concepts of real and reactive power.

3. The importance of real power.

4. Overall concept of distribution and utilization of electrical power was introduced to the students.

5. Results and Discussion

A survey was conducted for a class of 60 students with regular teaching and a class of the same number with integrated teaching method. It was observed that in integrated teaching methodology the students showed better interest and response in the class. The understanding of the subject and also the confidence of implementation of the concept was better developed in the students.

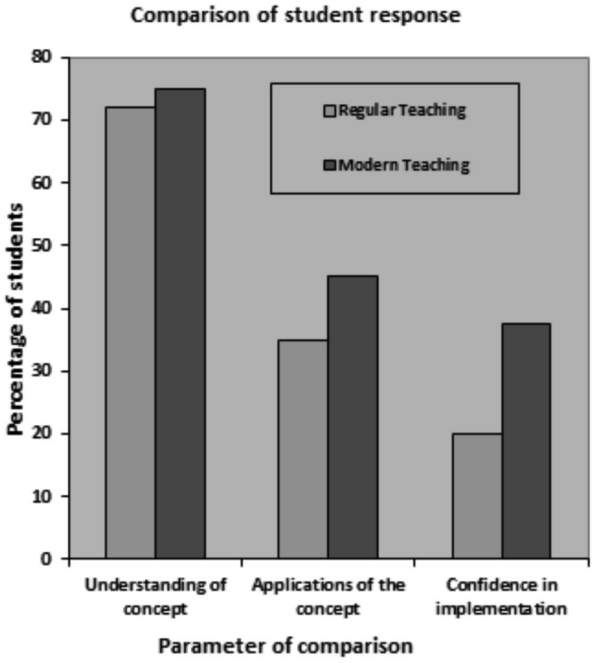

Fig. 2 Comparison of Survey

6. Conclusion

The experiments 1 and 2 helped the students of different grades understand clearly the concepts required at their level. The students were able to understand the practical implementation of the theoretical concepts. It evokes a thinking process in the students that makes them more sensitive of the world around them and how they can find solutions to the existing problems. It develops confidence in the students that they have a grasp of their subject and can practically implement it for solutions of various problems around them and the industries. Thus, they find themselves more fit and suited for industrial jobs.

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