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Outcome Based Education—Some Initiatives

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Abstract

Engineers & technologists contribute significantly in our social development, economic progress, and enhancement of social and physical infrastructure. Industry in general and manufacturing in particular are facing unprecedented challenges due to globalization. Consequently, the business environment of manufacturing enterprises is facing increasing complexity. The engineering graduates and researchers with the ability to understand the technological complexities, the creative arts and skills are increasingly sought after by industrial and business world. Team-based activities are of great importance for students to learn and tackle and solve the complex global issues at later life. Self study and own initiatives of engineering students at learning stage enable and sharpen them to emerge out as highly acceptable engineers. The Washington Accord which emphasizes on outcome based learning is gaining increasing acceptance among many countries.

Keywords

Outcome Based Education, Self Study & Initiative, Team Projects, Term Paper

1. Introduction

It is a known issue that education is slow to change especially in implementing new concepts and technologies. This is described by Jukes and McCain [1] as paradigm paralysis, in which the delay or limit in our ability to understand and use new technology is due to previous bad experiences. It takes new experiences to replace the old ones, and this is taking a long time. Education reform can no longer afford such a prolonged duration. The technology changes are fast arriving than education is preparing to cope up with. We therefore need to tackle this situation with new ideas and adapt the education to the changing needs.

When the rate of change inside an institution is less than the rate of change outside, the end is in site... Jack Welch, CEO of General Electric [2].

Right now, education is moving along at a snail's pace, while the world outside is speeding up by at a supersonic rate. According to Fulton [2] (1989, p. 12), "Classrooms of today resemble their ancestors of 50 and 100 years ago much more closely than do today's hospital operating rooms, business offices, manufacturing plants, or scientific labs. If you put a doctor of 50 years ago in today's operating room, he would be lost, yet if you placed a teacher of 50 years ago into one of today's classrooms he wouldn't skip a beat". This means, the education's progress is very poor and teaching-learning process requires taking a big leap. The Washington Accord which deals with the improvement of Technical Education is an International Accreditation Agreement for accrediting professional engineering academic degrees. It was initiated in the year 1989. India gained provisional

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status in 2007 and subsequently was accorded signatory status on 13th June 2014 at Wellington, New Zealand. This accord is gaining increasing importance among many countries.

2. Education Technologies

We don't have to look hard to find teachers utilizing new technological tools to replicate old educational models. For example, we find that most of the distance education institutes employ the same instructor delivering the same lecture to the same audience. Now the difference may be that the audience can be larger. This distance education model does nothing to address the concept of lifelong learning. This traditional model places the student in a passive role, merely absorbing as much information as possible. Instead, more collaborative models of distance education could be employed. For example, one can use live video connections with partner universities to bring together professors and students in a forum where all parties contribute and benefit from the collaborative learning experience. However, the overall dependence on the traditional instructional model dominates the majority of today's educational system.

"Just-in-Case" to "Just-in-Time"

Much of the failure to utilize technology in education today is, as Thornburg [3] puts it, "the assumption that content [is] king... in a world of rapid information growth, it is context that matters... context is king" (in Thorburg, 1997, p. 5) [4]. Thornburg [3] advocates that rather than teach students a stockpile of facts to use "just in case" they might need them some day, "Just in time" learning be put in context—*i.e.* master the ability to gather the appropriate facts and then creatively leverage those facts towards the learning objective. Teaching should create situations where the students are required to locate the facts and information specifically related to the context of the question at hand, and then to utilize that information effectively. Rather than having students learn facts "just in case" they might need them some day, it is better to put them to "just in time" learning; collaborative learning environments where groups of students find solutions to real world scenarios.

3. Curriculum

Apart from acquiring the necessary knowledge, skills and competency of the particular discipline, the engineering graduate has to develop certain soft skills, which may have to be acquired not directly from the curriculum but from involvement in co-curricular activities. It is useful here to refer to the Accreditation Manual where these attributes such as the following are stated:

a) Ability to acquire and apply knowledge of science and engineering fundamentals;
b) Ability to communicate effectively, not only with engineers but also with the community at large;
c) In-depth technical competence in a specific engineering discipline;
d) Ability to undertake problem identification, formulation and solution;
e) Ability to utilize a systems approach to design and evaluate operational performance;
f) Understanding of the principles of sustainable design and development;
g) Understanding of professional and ethical responsibilities and commitment to them;
h) Ability to function effectively as an individual and in a group with the capacity to be a leader or manager as well as an effective team member;
i) Understanding of the social, cultural, global and environmental responsibilities of a professional engineer, and the need for sustainable development; and
j) Expectation of the need to undertake lifelong learning, and possessing/acquiring the capacity to do so.

The engineering colleges must be sensitive to the state of marketability and employability of their graduates. They will endeavour to "dance to the ever changing tune" as required by the industry as far as possible, but there are technical as well as financial constraints; and further the caution is that any new changes to a programme need at least five years to establish and bear fruit.

Out Come Based Education

One of the more newly-introduced factors in the engineering programme evaluation process is the Outcome Based Education (OBE) approach. The institution or a college must be able to show evidence that it is fully committed to embrace the OBE approach and show progress towards this direction. The Washington Accord

(WA) elaborately contains this concept. This accord gained acceptance by several countries. Following are the current permanent signatory countries for the (WA).

Australia—Represented by Engineers Australia (1989)
Canada—Represented by Engineers Canada (1989)
Chinese Taipei—Represented by Institute of Engineering Education Taiwan (2007)
Hong Kong China—Represented by The Hong Kong Institution of Engineers (1995)
India—Represented by National Board of Accreditation (2014)
(*Applies only to programmes accredited by NBA offered by education providers accepted by NBA as Tier* 1 *institutions.*)
Ireland—Represented by Engineers Ireland (1989)
Japan—Represented by Japan Accreditation Board for Engineering Education (2005)
Korea—Represented by Accreditation Board for Engineering Education of Korea (2007)
Malaysia—Represented by Board of Engineers Malaysia (2009)
New Zealand—Represented by Institution of Professional Engineers NZ (1989)
Russia—Represented by Association for Engineering Education of Russia (2012)
Singapore—Represented by Institution of Engineers Singapore (2006)
South Africa—Represented by Engineering Council of South Africa (1999)
Sri Lanka—Represented by Institution of Engineers Sri Lanka (2014)
Turkey—Represented by MUDEK (2011)
United Kingdom—Represented by Engineering Council UK (1989)
United States—Represented by Accreditation Board for Engineering and Technology (1989)

4. Few Steps towards Washington Accord

4.1. Team Projects Lab

India being the signatory to the Washington accord, it is worthwhile to carry out few exercises in teaching learning process and to observe the learning outcomes. The authors have taken initiative in introducing a practical oriented subject entitled "Team Projects Lab" in the latest curriculum of four year Mechanical engineering degree course at III year II semester level. This practical learning subject aims at inducing a group of students to identify for themselves a Technical Problem of Immediate social relevance with the help of a teacher. Entire class of 60 students is divided into 12 teams of 5 students each and one common teacher is attached to every three teams. Each team of students selects ideas and works on such ideas and problems. The common teacher of the three groups extracts several points and ideas from each of the three teams. He then shares them with other teams within his three teams. This arrangement prompts the teacher and his teams to be live with various ideas and it churns out competitive and dynamic environment in the department laboratories.

At the rate of one teacher for every three teams, there will be four teachers for 12 teams of a class. All the teams will be simultaneously working in various laboratories of the department, at a given time slot. The above environment enables the students to initiate their own ideas, plan their own course of action to give shape to their ideas and to work with their own hands, at their own phase. Healthy competition and collaborative attitudes are expected to stem out spontaneously. The teacher remains merely as a facilitator or a coach. A suggested list of Exercises (but not limited) given at **Table 1** are prepared to work as a prompt to the students. The aim in introducing such lab has been to train them to make an initiative of their own, and enable the students to test their learning outcomes, at the end of two and half years of their course, and prepare them for a larger project to be taken up at the end semester of the 4 year degree course. Presently this lab is introduced only for Mechanical Engineering students, as a trial.

4.2. Term Paper

It is desirable to bring out the challenging spirit in young students, both boys and girls. There are always a few students who want to meet a challenge. With this backdrop, students are given an opportunity to come forward voluntarily to prepare a detailed paper and present it too in a class room, on a topic given to them by the teacher. Few topics have been prepared in "Machine Tools" subject and have been assigned to the volunteered students. A special certificate is proposed to be given to those who successfully prepare and present a paper called "Term Paper".

The above concept has two intentions. One is to identify and give an opportunity to those students who want to excel and the other is to induce the passive students to get activated. Few topics that were given are listed in **Table 2**.

Topics have been assigned to a group of 13 student's @ one topic to each student. 13 students volunteered to prepare and give an audio visual presentation at the end of the semester.

Table 1. Exercises for team projects lab.

Sl. No	Exercises
1	Analysis and design of air blowing units like a ceiling fan or an air blower.
2	Ergonomic design of writing tables, for students.
3	Pillion rider safety unit for a motor cycle.
4	Electrical energy generation at speed breakers on high ways.
5	Design and fabrication of opening and closing of compound gates of individual houses, by remote control method.
6	Power generation from municipal waste. An executive plan for a profitable venture.
7	Design of solar water heater for canteens and hostels with appropriate timers and controllers.
8	Canteen hygiene & mechanized washing unit for vegetables, vessels etc.
9	Design of pigeon cum fishery unit in open grounds (lawn) of educational institutions & utilization of canteen waste.
10	Design and manufacture of novelty items in technology labs of engineering institutions.
11	Develop a feasibility plan to utilize solar energy to operate a submersible water pump for agricultural use.
12	Manufacturing unit for cement bricks used in civil construction work and for movable road divider blocks.
13	Design and manufacture of metallic can crusher.
14	Basic design of pelton wheel.
15	Stress analysis of a simple car frame.
16	Horizontal axis wind turbine.
17	Simulation studies on automobile shock absorbers.
18	Fire fighting robots.
19	Designing a bar feeding mechanism for general purpose lathe.

Table 2. Term paper topics.

Sl. No	Topics
1	Analysis and design of air blowing units like a ceiling fan or an air blower.
2	Cutting forces in metal cutting (turning, drilling and milling).
3	Single and multi spindle type automatic lathes.
4	CAM design.
5	Taper turning attachment.
6	Planing machine—principle parts & kinematic diagram.
7	Jig boring machines.
8	Deep hole drilling machine.
9	Types of milling machines & operations.
10	Grinding wheels and their composition—selection of grinding wheels.
11	Cylindrical grinding machine—principal parts of the machine, applications.
12	Broaching machines & tools (types of machines & broaches).
13	Principles of jigs & fixtures, drill jigs.

5. Conclusion

It is very important to identify the technical ideas that are born in the mind of the student and nurture them jointly by the teacher and the student to give a practical shape to such ideas. The ambience for learning is more encouraging when the student's own ideas are given greater importance than for the ideas listed by a teacher. Giving an assignment to a limited group of volunteering students in a class is expected to motivate the other students also to take up a similar assignment voluntarily in the later semester. The process, when successful, may emerge out as one of the most useful methods of teaching-learning process.

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