

A Preliminary Study on the Relevance of Outcomes - Based Education in Engineering-A Student Centric Approach

Anoosha Pai S¹, Nikhil.H.N², Rajath A Sridhara³, Madhav Murthy⁴

^{1,2,3,4}Department of Mechanical Engineering
B.M.S College of Engineering, PO Box 1908
Bull Temple Road, Basavangudi, Bengaluru 560019 Karnataka, India
¹anooshapai@gmail.com
²nikhillhn1994@gmail.com
³a.rajath9@gmail.com
⁴madhavmurthy.mech@bmsce.ac.in

Abstract: This paper reveals the necessity of Outcomes-Based Education (OBE) in current engineering education. Here an effort has been made together information from students currently pursuing engineering across various colleges having substantial variation in the curriculum, in the state of Karnataka as well as at a national level. The method adopted to conduct the survey was questionnaire. The findings of the study indicated that the outcome based approach is more effective when compared to conventional teaching-learning methodology.

Keywords: Outcomes-Based Education; Alternate Assessment Tools; Self-Study; Course Outcomes; Engineering; Curriculum.

1. Introduction

Outcomes based education (OBE) is a process that involves restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of higher order learning and mastery rather than accumulation of course credits [1]. The learning process in OBE is student-centred rather than lecture-based, as in the conventional approach. It attempts to embrace learning outcomes with the knowledge, skills, attitudes and values that match the immediate social, economic and cultural environment of society. It clearly focuses on organizing everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences. This means, starting with a clear picture of what is important for students to be able to do, then organizing the curriculum, instruction, and assessment to make sure this learning ultimately happens. As a result of having OBE, knowledge gained through learning can be easily matched with standards all over the world. This, in turn makes the students well versed with what they are required to learn in the course so that they can utilise it for their career.

Traditional methods, such as a lecture-based session, were developed before textbooks were mass-produced. This often involved delivering as much information as quickly as possible. The lecture method was found to be one of the most efficient ways to propagate information and has often been used for this purpose. Because some faculty may not be effectively delivering the content, and because

Anoosha Pai S
Department of Mechanical Engineering
B.M.S College of Engineering, PO Box 1908
Bull Temple Road, Basavangudi, Bengaluru 560019 Karnataka, India
anooshapai@gmail.com

students are often poor contributors in the lecture, this type of teaching has often allowed students to be passive in the classroom. Students not knowing how to be active participants in the lecture have relied on dictation, memorising and repetition in order to learn the subjects [2]. However, it was found that students perform considerably better when they are put through the process of learning the curriculum when the outputs of the curriculum are specified, rather than by teaching them in the traditional ways.

Outcome-based education has gained prominent recognition internationally in order to promote educational reforms and policies. As a result, OBE has been implemented in various countries like USA, Canada, Australia, New Zealand, South Africa, Hong Kong and Malaysia to name a few.

2. Objective of Study

1. In this study, an attempt has been made to broadly evaluate the existing engineering curriculum in India, based on recipients' perception.
2. To Conduct a survey on engineering students and to analyse the awareness & implementation of OBE, directly or indirectly.
3. To compile the evaluated data obtained from different institutions with varying curriculum in the state of Karnataka as well as across India.
4. To facilitate utilisation of evaluated contents in restructuring of future curriculum and adopting enhanced methodology for teaching and learning process.

3. Literature Review

The concept of outcome-based education developed in the 1980s and 90s, is most commonly associated with William Spady [6].

According to Spady (1994), Outcome-Based Education means clearly focusing and organizing everything in an educational system (curriculum, instructional strategies, assessment and performance standards and so on) around what is essential for all students to be able to do successfully at the end of their learning experiences.

Spady's "OBE Paradigm" is based on three premises and four principles.

The premises are:

1. All students can learn and succeed but not on the same day and not in the same way.
2. Successful learning promotes even more successful learning.
3. Schools control the conditions that affect directly affect successful learning.

The four "power principles" are:

1. Clarity of focus on culminating outcomes of significance;
2. Expanded opportunity and support for learning success;
3. High expectations for all to succeed; and
4. Design down from your ultimate, culminating outcomes [6].

There are various examples of successful studies done on the implementation of OBE in different colleges around the world. These studies on OBE are not restricted to just engineering curriculum but cover diverse subjects like nursing, military, social sciences and primary schools etc.

Rosdiadee Nordina, A. Ashrif A. Bakara, Nashruddin Zainala and Hafizah Husaina studied students' grades in a public university in Malaysia before and after an industrial talk covering certain Course Outcomes (COs). They found that the grades improved after the industrial talk and the students' knowledge base increased [3].

Oriah Akir, Tang Howe Eng and Senian Malie's studies showed that with use of technology through e-learning and teaching and learning enhancement through outcome-based education structure in a university in Malaysia, the mean grade point average for OBE students was significantly higher as compared to non-OBE cohorts [4].

Noko Jones Ramoroka mentions in his report that educators in the South African Education System have little understanding of OBE and its principles, and do not accommodate said practices in their classroom assessment. He finds that the educators must be made to understand OBE so that it can be implemented effectively [5].

There are six international agreements governing mutual recognition of engineering qualifications and

professional competence. In each of these agreements countries who wish to participate may apply for membership, and if accepted become its members. In engineering education, the outcome based approach has been mandated as compulsory for accreditation of an engineering programme for signatories to the agreement [7].

The three agreements covering mutual recognition of substantial equivalence in the accreditation of tertiary-level qualifications in engineering [7]:

The Washington Accord (1989) - For professional engineering. Normally for four years.

The Sydney Accord (2001) - For engineering technology. Normally for three years.

The Dublin Accord (2002) - For technician engineering. Normally for two years.

The other three agreements i.e. APEC Engineer agreement (1999), International Professional Engineers agreement (2001) and International Engineering Technologist agreement(2003) cover recognition of equivalence at the practising engineer level i.e. a person recognised in one country as reaching the agreed international standard of competence should only be minimally assessed (primarily for local knowledge) prior to obtaining registration in another country that is party to the agreement [8].

Statistics reveal that there are about 3400 Engineering Colleges in India. Of these, 40 institutions are accredited currently under tier 1 status under NBA[9].

4. Methodology

This study was conducted with a sample of 610 students across different branches from different engineering colleges all over India (Refer Appendix 1 & 2). Data for this study was gathered during the period from 1st September to 15th September 2015.

To conduct the survey, a suitable questionnaire was designed (Refer Appendix 4). The questionnaire majorly consisted of 3 groups which covered various aspects involving OBE. There were 18 questions in which eight dealt with the topic of awareness; seven questions were linked to the sub-section that established the impediments to OBE; whereas seven

dealt with the different methods of implementation. Overall, three questions were interrelated to all the groups.

The first group of questions was to collect information on the awareness of OBE amongst the engineering students. Even though it was known that OBE is not followed in most schools of engineering in India, this group of questions made an attempt to find out if at least the students were aware of the quality of the curriculum and the corresponding facilities provided by their institutions.

The second group of questions was focused on the hindrance for effective implementation of OBE in engineering education. An attempt was made to find out the interest and involvement of students and faculty in effective execution of OBE.

The third group consisted of questions that helped in gathering information on the most effective methods and alternate assessment tools as preferred by the students in better understanding of the course.

The questionnaire survey was carried out from 15th to 25th September 2015. The online survey was conducted on two websites namely Google Forms and Survey Face, both free-to-use websites. Responses were also collected through one to one interaction.

Further, the collected data was compiled and appropriate conclusions were drawn from the data.

5. Results and Discussions

The data analysis was carried out with the help of pie charts and bar graphs. A few essential graphs and pie charts are mentioned here.

Introduction of Outcome-Based Education in engineering has become a prime factor in the enhancement of the existing curriculum. Meeting global standards by having an Outcome-based Education is the talk of the town with prominent changes being made so as to have better outputs from the graduates. It was observed that roughly 37% of the students said that the main motive of their study was to gain knowledge in their field, while some (30%) said procuring a job oriented them the most and for a few others (21%) developing skill sets inspire them. As observed, the mixed responses given by the students matches the major goal of OBE i.e., is to improve the technical expertise by familiarising themselves with

the prescribed topics in various courses and correlating it to the current scenario.

The graduates are required to develop critical thinking, creativity and analytical skills. On being asked a question on how often they apply their engineering skills daily, the most picked answers were 'sometimes' (50%) followed by 'rarely' (35%) with 'always' coming a far third (10%).

Hence, with better outcome there can be better quality engineers. Graduating from an Institution with OBE prepares the students with all essential tools required by an industry, whether local or international.

The students being aware of the engineering curriculum not meeting up with the industrial expectations are to be noticed. The students also feel that the gap between their current engineering syllabus and the industry requirement is very wide. Around 38% and 33% marked the prospectus of their curriculum between 2 (fair) and 3 (good) respectively, on a scale of 1 to 5 with 1 standing for poor and 5 for excellent (Refer Fig. 1). Thus, engineering syllabus can be considered as one of the impediments for the implementation of OBE.

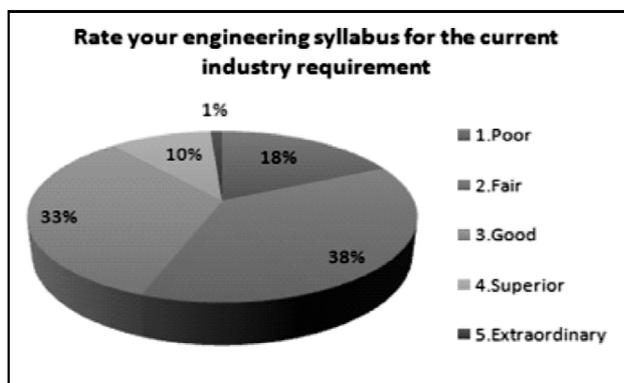


Fig 1. Response on rating of the curriculum

Several students (48%) also admit to being 'somewhat' aware of the current research in the industry of their domain while few more (32%) agree on being 'slightly' aware, and handful (14%) of them disclose that they are unaware, with a very few (6%) selecting the option-'completely aware'. This means that there is some amount of awareness of the latest developing trend among the students, which they would have gathered either through internships or industrial visits. Consequently, fundamentals are utmost essential for any graduate to be well equipped as per the industry demand.

Although most of the students being somewhat aware of current ongoing trends in their field, it is essential that awareness about the same can also be discussed by the respective faculty handling a particular course. It was found that 60% of the students felt that the proficiency of the faculty handling the course was good/average with only 2% agreeing to their teachers being excellent (Refer Fig. 2). With proper training for the faculty, the subject can be made more interesting to learn. Thereafter implementation of OBE becomes easier.

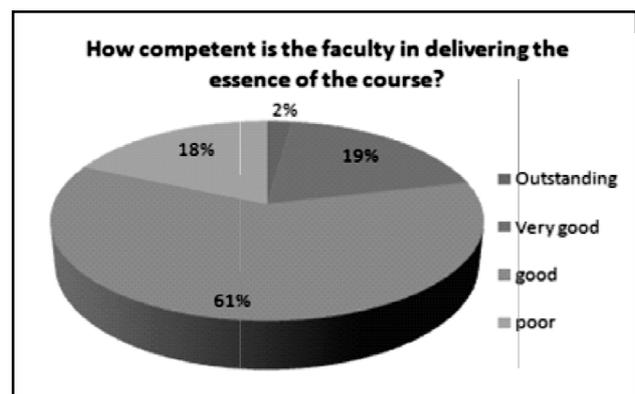


Fig 1. Response on Competency of the faculty

The collected data says 49% of the students 'sometimes' utilize the facilities provided by the college for research, projects and so on, with 34% of them 'rarely' utilising the same. Most institutions providing adequate facilities for research related activities have students who fail to use the same. On the other hand, there are some colleges not having these amenities as well. This ambiguity in the response could not be determined. Hence, only with basic necessary facilities in every institution being easily accessible by every student, OBE can be successively implemented.

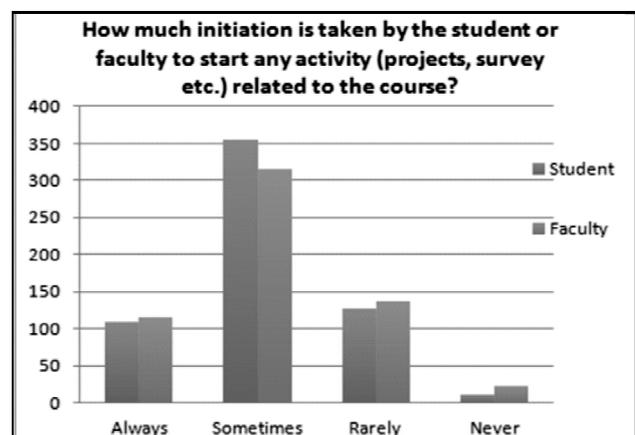


Fig 1. Response on initiation taken by student/faculty for any technical activity

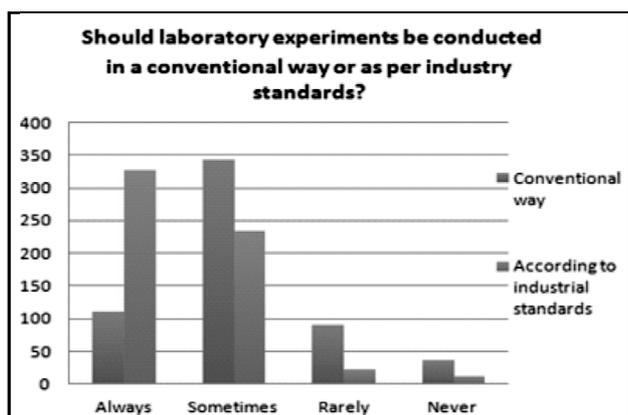


Fig 1. Response on preference regarding conduction of laboratory experiments

Majority of the students prefer to have experimentation conducted in the laboratories to be partly conventional and partly according to industrial standards (Refer Fig. 4). Here, industrial standards imply the experimental approach and interpretation as is carried out by any industry. This in a way compels a student to think rationally and gives better exposure for research and opportunity to question the general protocol followed for every experiment.

Students do not feel the need to devote more time with regards to co-curricular activities which expand their horizon on wide range of different subject related topics. Almost half of the respondents (48%) admitted to spending only 1-3 hours per week on activities related to the courses with 29% of the students choosing the option 'less than 1 hour'. With students themselves showing minimal concern, effective execution of OBE becomes difficult

Finally, a variety of student favoured methods to implement OBE can be adopted apart from the routine classroom teaching. By conducting workshops, industrial visits (29% each), guest lectures (10%), seminars (11%), online courses (12%) and initiating inter and intra collegiate level technical student chapters, better student-student, student-faculty and student-industry interaction can be accomplished. These are highly demanded by the students and the same should be made available to them.

Over 70% of the respondents believe that it is extremely important for application oriented subjects to be taught by Industrial Experts at undergraduate level and only 2% of them did not agree to this proposition. But, this is yet another way to achieve better course outcomes in engineering.

With respect to alternate assessment tools (AATs), the order of preference as indicated by the undergraduates to gather information were presentations (40%), projects (29%), open book exams (16%) and surveys (14%).

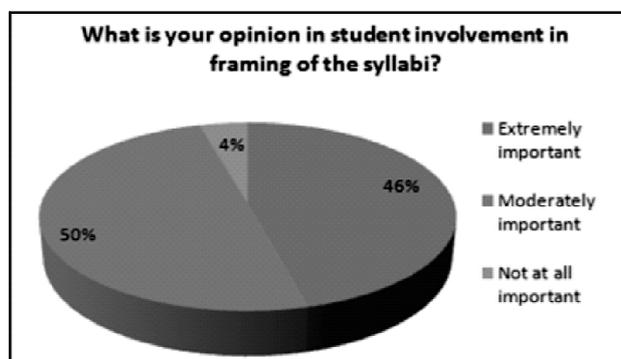


Fig 1. Response on opinion about student involvement in framing of syllabus

About 96% of the students felt that they should be involved in the framing of the course syllabus, with 46% of the students viewing this activity to be extremely important and 50% of them marking moderately important (Refer Fig 5). Also in this context, 53% and 31% of the respondents respectively are of the opinion that it is extremely to moderately important to have courses like Constitution of India and Professional Ethics, Personality Development and Communication, Environmental Science and so on, for overall growth of an engineering student. From this data it is evident that students being the customers in academics, their involvement or feedback in structuring the curriculum may revamp the entire educational approach. Hence a panel of industrial experts and academicians framing appropriate syllabi along with student inputs may result in producing confident knowledgeable lot rather than work machines.

The internet is a powerful tool utilized by majority of the students in order to improve their technical skills. 87% of the students agreed that the usage of technology, both by faculty and students, is extremely essential in engineering education followed by 12% who feel that it is moderately essential (Refer Fig 6). Also students preferred to make use of the internet (43%) in order to complete any given assignments rather than applying learnt concepts (24%), referring to a friend (19%) and referring to course literature (14%). Clearly, a well-connected digital infrastructure in an institution can yield better quality graduates with better productivity.

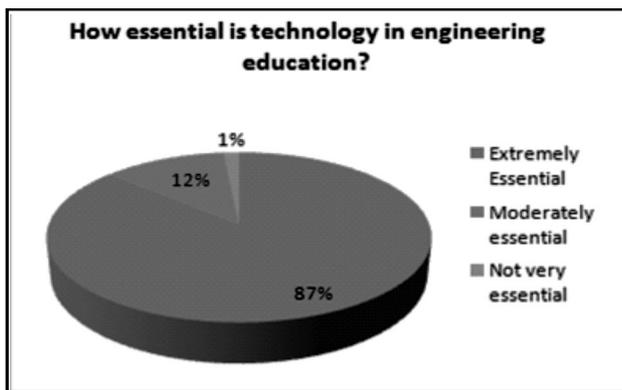


Fig 1. Response on need of technology in engineering education

Self-study is also a chief element of OBE. Introduction of self-study component is of utmost importance as concluded by majority (72%) of the students. Most of them agree that it must be included in their curriculum to better help them in utilizing their own creativity in learning the courses and about 19% of students could not decide on this. With self-study, students would be able to explore every course in an innovative way along with self-evaluation, thus expanding their horizon leading to better understanding and outcomes.

6. Conclusions

Outcomes-Based Education is an indispensable tool for the enhancement of educational practices in India. This being totally a student centric approach, the entire motive of the study focuses only on exploring various instances during which the students are direct or indirect recipients of OBE throughout their course of study. The questionnaire employed to conduct the survey was specially designed to identify if students were actually aware of new methods of learning and if realization of the same was done effectively. Students are an unconditional part of the academic system along with other stakeholders like Employers, Subject experts, Industry professionals, Academicians, Alumni etc. Here it is clearly noted that the students' inputs are also vital to decide on how best OBE can be incorporated in the existing curriculum and/or what suitable changes can be best made to boost the learning process. As it is evident from the results, unanimous response by the students on certain facts like introduction of self-study component in courses, need for better industry-institution interaction and so on, clearly indicates the immediate need to adopt the same hence bringing about improvement in the current academic field. Hence, there is a strong necessity to bring about

changes in the teaching-learning trend by adopting several effective alternative assessment tools. Overall, OBE not only helps in imparting better quality education but also better quality graduates.

References

- [1] Tucker, B. (2004). Literature review: Outcomes-focused education in universities. Retrieved October 19, 2004, from <http://lsn.curtin.edu.au/outcomes/docs/LitReview.pdf>.
- [2] Dr Maniam Kaliannan, Suseela Devi Chandran. Empowering Students through Outcome-Based Education. <http://www.jfn.ac.lk/OBESCL/MOHE/OBE-Articles/Academic-documents-articles/7.OBE-Empowering-students.pdf>.
- [3] Steve Y. W. LAM, Hong Kong SAR, China. (2009). Outcome-Based Approach to Teaching, Learning and Assessment in Geomatics Higher Education: the Hong Kong Experience".
- [4] Rosdiadee Nordina, A. Ashrif A. Bakara, Nashruddin Zainala, Hafizah Husaina. (2011). Preliminary Study on the Impact of Industrial Talks and Visits towards the Outcome Based Education of Engineering Students, *Procedia - Social and Behavioral Sciences* 60 pages 271 – 276.
- [5] Oriah Akir, Tang Howe Eng, Senian Malie. (2012). Teaching and learning enhancement through outcome-based education structure and technology e-learning support, *Procedia - Social and Behavioral Sciences* 62 pages. 87 – 92.
- [6] Noko Jones Ramoroka. (2007). Educators' Understanding of the Premises Underpinning Outcomes-Based Education and its Impact on their Classroom Assessment Practices, Thesis for Magister Educationis.
- [7] William G Spady. (1994). Outcome-Based Education - Critical Issues and Answers, American Association of School Administrators.
- [8] Information related to International Engineering Alliance, International Engineering Alliance, <http://www.ieagrements.org/>.
- [9] National Board of Accreditation. http://www.nbaind.org/Files/tier1_web_register.a_spx