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Outcomes-based Approach in Engineering Education for Special Education Need Students: Psychology and Rehabilitation Elements

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Abstract

Over the last several years, engineering education has made great progress by introducing Outcome-Based Education (OBE). The paradigm changes from teacher-centered to student-centered in teaching and learning have occurred with the outcome-based approach. Since the 1990s, outcome-based education has been applied globally. The acceptance of OBE occurred due to the signing of the Washington Accord. It is now required as part of certification by the National Board of Accreditation, the leading organization for assessing the quality of engineering schools in the United States. While the good outcomes of integrating OBE in engineering education seem unavoidable, the issue is whether faculty members are equipped to execute the technique. This study aims to explore the influence of OBE on engineering education. A survey is used to conduct the investigation. The observations are positive; the notion of OBE permeates Engineering education in terms of evaluation, delivery, reflection, assessment, and curriculum design, but further training in specific areas is necessary.

Keywords: Course Outcomes, Curriculum design Evaluation, Outcome-based education, Program Results, Special Education, Psychology and Rehabilitation

Introduction

Outcome-based education focuses on the learner's acquired information, skills, and attitudes. In the traditional educational system, less focus was placed on outputs and more on input, with the specific curriculum being produced and provided. William Spady is credited for reviving outcome-based education in the 1990s (Bhat et al., 2020). OBE entails explicitly emphasizing and arranging everything in the curriculum system that is necessary for all learning to complete the program/course/graduation effectively. It begins with determining what skills are essential for students to possess and then designing the curriculum, evaluation, and delivery. Finally, ensure that acquiring knowledge occurs (Datta et al., 2021).

Engineering education has one of the most critical ecosystems in the world. Around 6,000 institutions are operating in the year 2019 to provide engineering education at the diploma, undergraduate, and graduate levels (Radianti et al., 2020). With so many schools and graduates, the community as a whole is worried about the quality of those engineers. An International Engineering Alliance has been founded to safeguard the quality of technical education globally. There are three agreements governing mutual recognition between consenting countries: Dublin for technologists, Sidney for technicians, and Washington for engineers.

Outcome-based education is revolutionary in many ways as compared to traditional education, and its implementation requires significant changes in institutional rules, procedures, structures, and faculty members' attitudes. It must be applied methodically to enhance education and measure the quality of teaching and learning. The advantages to students ' learning and incentives make an effort required to execute it well worth it

(Wu & Wu, 2020). In light of the advantages and problems connected with adopting OBE, this research focuses on determining the extent to which OBE culture has permeated and on determining how well members of the faculty at engineering colleges are familiar with the various procedures and concepts related to OBE (Johnson & Ramadas, 2020).

Theorizing and Applying Outcome-Based Education

Accreditation of engineering programs is a primary driver of OBE adoption. The National Board of Accreditation has established protocols, self-study reports, and other criteria for evaluating engineering schools. Curriculum design, course outcomes, accomplishing these objectives, and program outcomes are significant considerations in determining accreditation. Accreditation is granted to two categories of engineering schools: Tier-I and Tier-II, which are distinguished by their degree of autonomy in carrying out academic activities. Tier-I contains autonomous institutes connected with affiliating universities that develop their curriculum, administer exams, and report results.

Additionally, it covers national institutions of importance and colleges that are not affiliated with other schools. Tier-I institutions can more successfully apply OBE than Tier-II institutes since they can align their policies, procedures, and evaluation techniques with OBE. Tier-II institutions are those that are affiliated with colleges and depend on them to develop curricula, administer exams, and announce results (Binu et al., 2020).

In OBE, the term "product" refers to the thing that characterizes the process. OBE may be defined as outcome-oriented thinking; It's the polar opposite of input-based education, in which the focus is on the teaching process, and we're satisfied with whatever outcomes appear" (Rathy et al., 2020). Curriculum choices in OBE are guided by the learning goals that students should achieve after the course. Thus, it is the responsibility of the school and faculty members to ensure that the programs give a balance of program-specific information and complementary knowledge areas, skills, and attitudes, and the capacity for lifelong learning (Saravanan et al., 2021; Yasmin & Yasmeen, 2021). The primary prerequisites of OBE include clarity in the program's aims and objectives, adequacy of instructional techniques for the development of desirable abilities, and a variety of assessment processes capable of consistently monitoring whether or not desired targets are fulfilled. The steps of development and delivery of OBE are shown in Figure 1.

- • Deciding Establishing the qualifications' goals and objectives and the abilities and competencies required of a qualified engineer. It contributes to the Graduate's characteristics. It is informed by feedback from stakeholders like accrediting agencies, industries, the government, and professional associations.
- Curriculum framing: Organizing material and learning activities following the needs necessary to accomplish objectives.
- Feedback and redevelopment: Tactics are modified if specified results are not achieved.
- Delivering programs and assessing results: Providing teaching, learning, and evaluation methodologies to support creating and measuring desired objectives.

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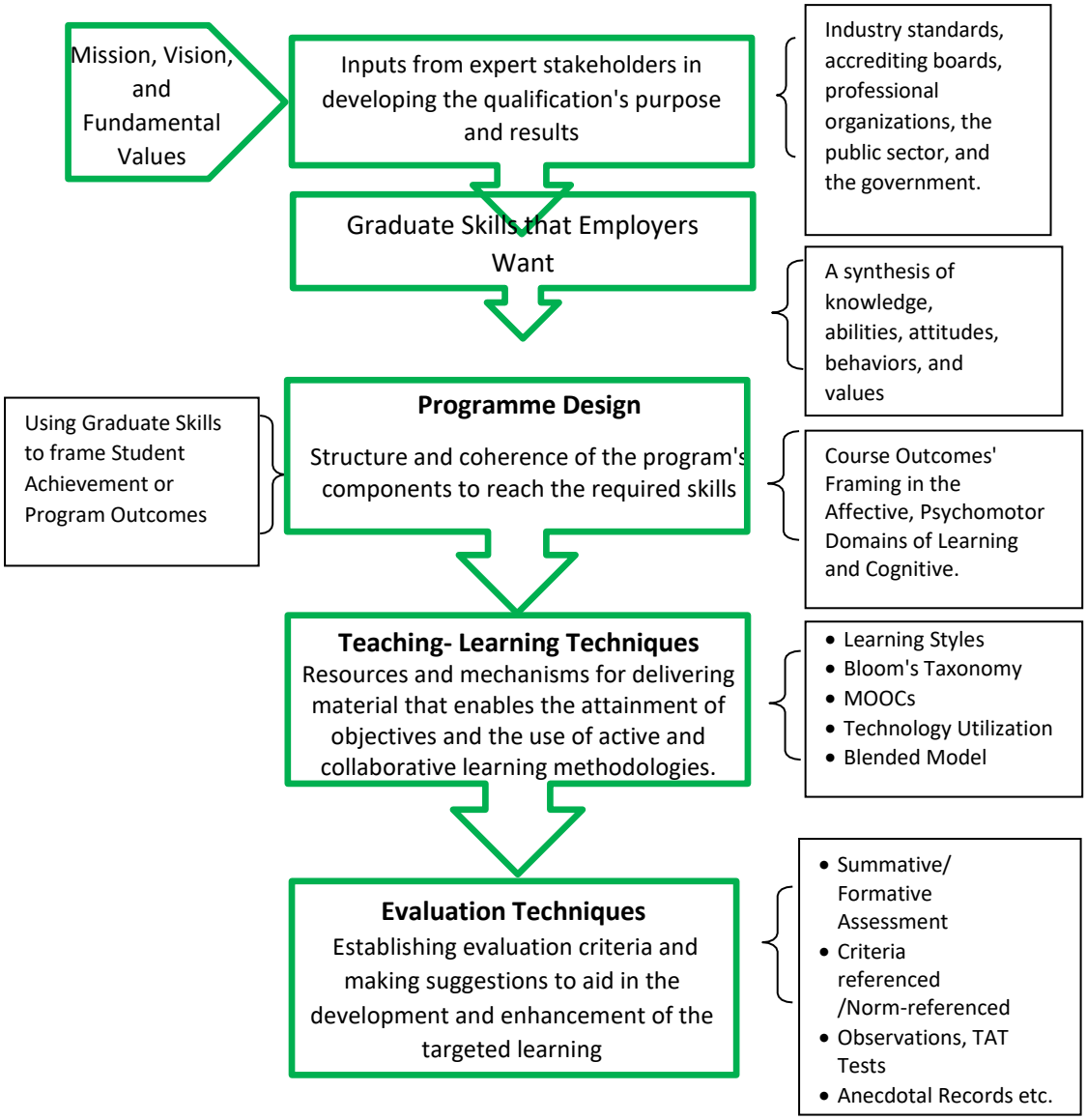
Figure 1. Outcome-Based Education Processes



Methodology

A survey is conducted to elicit comments from faculty members around the nation about their methods and attitudes toward OBE. It comprised instructors from tier I and tier II institutions. Additionally, this study included instructors from many designated institutions. A questionnaire was created and sent to instructors through Google forms, and answers were gathered. We obtained 1246 anonymous replies; faculty members were not compelled to reveal their identities. The questionnaire contains the following questions:

1. Are you capable of deciphering the significance of OBE?
2. Are you capable of writing Course Outcomes that are appropriately aligned with Program Outcomes/Graduate Attributes?
3. Which strategy do you use while creating curricula?
4. To what degree does your evaluation strategy cover all COs and the whole course syllabus?
5. When writing COs, may we utilize action verbs such as grasp, make informed of, and capable of knowing?
6. How do you create course outcomes for your course?
7. Are you familiar with the terms Cognitive, Affective, and Psychomotor domains of learning?

8. Are you familiar with various assessment/evaluation techniques, like anecdotal records, norm/criterion-referenced testing, summative and formative assessments, projects, and observation methods, among others?
9. Do you consider that OBE contributes to improving engineering education's quality?

The questions were constructed to assess the participants' understanding of various processes and concepts associated with OBE. It includes questions regarding OBE comprehension, outcome statement framing, the curriculum design process, diverse teaching styles, and non-traditional assessment approaches.

Results and Discussions

In some situations, the results were positive and consistent with the goal of widespread OBE culture in engineering colleges, while others need improvement.

OBE Terminology Interpretation and Curriculum Design

Around 85% of responders agree or strongly agree that they can grasp the meaning of OBE. Nearly 46% of respondents believe that they should first create learning objectives before preparing a syllabus, while the remainder has a syllabus in place and then write learning outcomes. Their autonomy might explain this inconsistency in developing curricula. As seen in Figures 2 and 3, the replies are as follows:

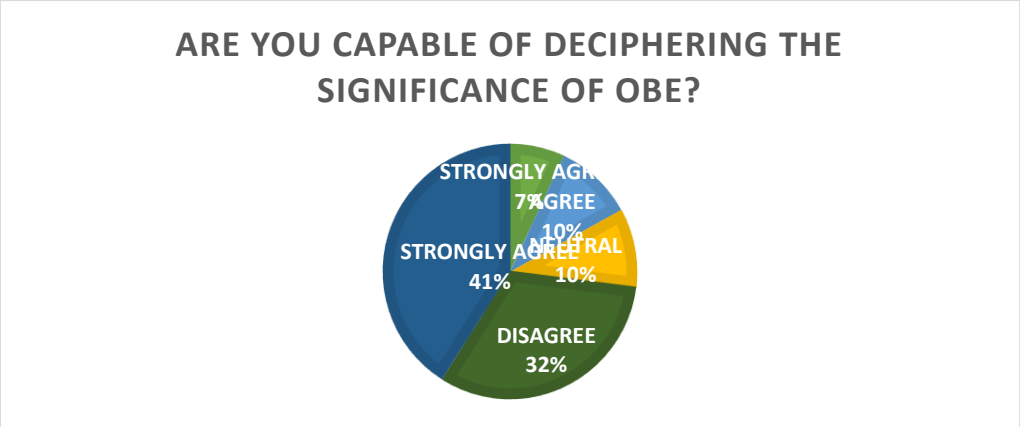


Figure 2. Response to the Outcome-Based Education interpretation

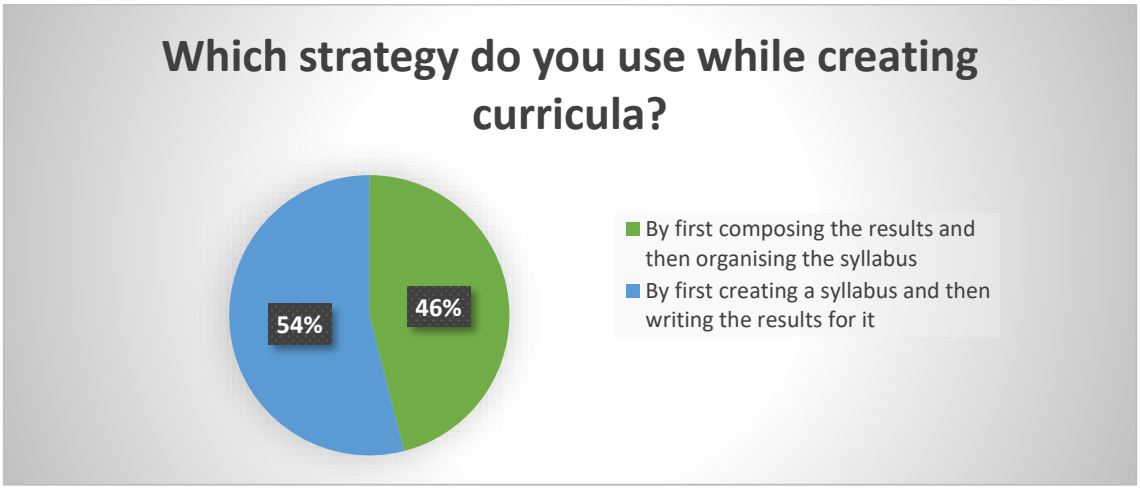


Figure 3. Answers for creating curriculum

Course Outcomes and fields of knowledge

Course outcomes (CO) are critical in OBE since they relate to the abilities needed of a successful engineer. It is necessary to establish correlations between program outcomes (PO) or student learning outcomes and course

outcomes. As a result, CO assertions must be validated and their mapping to PO. This poll asked about framing COs, proper mapping, and domain learning. 46% of respondents can appropriately write COs and associate them with POs.The rest can perform it modestly and may seldom need assistance. When developing COs, attention must be made to ensure that they begin with action verbs that are quantifiable or observable, are thorough, and are linked to the various levels of Bloom's taxonomy.

Additionally, faculty members should be familiar with the cognitive, psychomotor, and emotional learning domains. According to the research, 54% of respondents write total course learning outcomes over the whole curriculum of the course, taking into account the various levels of the taxonomy. Rest 37 percent write a single CO for a single topic without considering other cognitive levels that may be more suited. This proportion is the same for those who agreed to OBE interpretation and those who did not.

Since action verbs such as comprehend, make aware of, and capable are not allowed since they are neither observable nor quantifiable, 58 percent of respondents can appropriately write COs. Interestingly, although 79% of respondents are familiar with all three types of knowledge (psychomotor, cognitive, and emotional), but only 9% are familiar with the various levels of learning associated with each kind.

Evaluation and evaluation instruments

Assessment knowledge is vital since it is the last stage in determining if students have acquired certain information, abilities, or behaviors. Additionally, it is crucial to be familiar with various evaluation tools (Violante et al., 2020). Any assessment must include assessment criteria and mapping learning outcomes to those criteria to determine whether or not learning occurred. Thirty-nine percent of participants have mapped all COs to special assessment plan events, 46 percent have mapped 50-75 percent of COs, and the remaining 15% have mapped fewer than 50 percent of COs. Figures 4 and 5 show the distribution chart. Only 42% of participants are familiar with all of the evaluation tools indicated in the question, and 58% are familiar with only a handful. As far as the evaluation is concerned, participant knowledge is not very promising. Assessment and evaluation procedures should be improved.

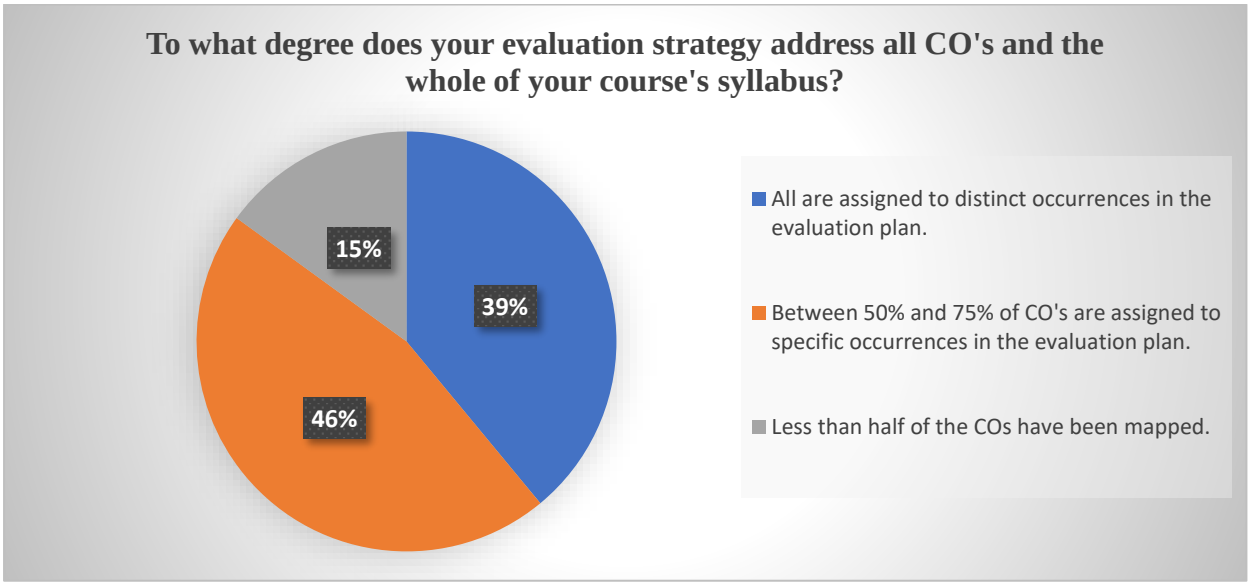


Figure 4. Answers for mapping of COs with evaluation plan

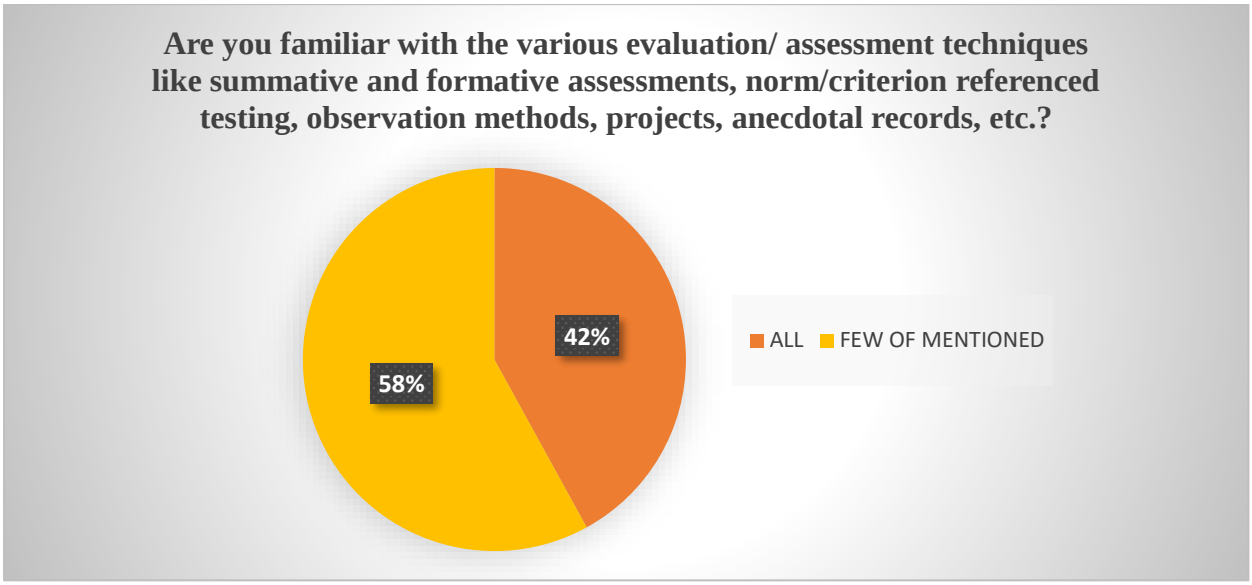


Figure 5. Various evaluation/assessment techniques

Conclusion

As a disruptive educational system, Outcome-based education is critical for enhancing the quality of engineering education. Institutions have embraced outcome-based education as a condition for worldwide acceptance of engineering degrees and certification of programs, but they must overcome implementation obstacles. The study's findings indicate that although the idea of OBE is gaining traction in engineering education, training in specific areas like curriculum design, drafting accurate COs, evaluation, and assessment procedures should be offered to get the most out of the Outcomes-based approach.

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