International Journal of Information Technology and Management
Vol. 19, Issue No. 2, August-2024, ISSN 2249-4510

DOI: https://doi.org/10.29070/hvjh9a45

Identifying Obstacles to the Adoption of Outcome-Based Education (OBE) in Engineering Education: Challenges and Solutions

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Abstract: Outcome-Based Education (OBE) has gained prominence in engineering education as a student-centric approach that focuses on measurable learning outcomes. However, its adoption faces several challenges, including resistance to change, inadequate faculty training, lack of institutional support, misalignment with traditional assessment methods, and resource constraints. This study identifies key obstacles to OBE implementation in engineering institutions and explores potential solutions to address them. Strategies such as faculty development programs, policy reforms, improved assessment frameworks, and technological integration are discussed. By overcoming these barriers, engineering education can enhance student learning, improve graduate employability, and meet accreditation requirements effectively.

Keywords: Obstacles, OBE, Engineering, Education

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INTRODUCTION

Engineering education is evolving to meet the demands of an increasingly dynamic and technology-driven world. Traditional teaching methods, which emphasize rote learning and theoretical knowledge, are being gradually replaced by more student-centric approaches such as Outcome-Based Education (OBE). OBE focuses on defining clear learning outcomes and ensuring that students acquire the necessary skills, knowledge, and competencies required for their professional careers. It aligns educational objectives with industry needs, accreditation requirements, and global standards. Despite its potential benefits, the implementation of OBE in engineering education faces several challenges. Many institutions struggle with resistance to change, inadequate faculty training, limited institutional support, and difficulties in designing appropriate assessment mechanisms. Additionally, resource constraints and the misalignment of curricula with OBE principles hinder effective adoption. This paper aims to identify the key obstacles to the adoption of OBE in engineering education and explore possible solutions. By addressing these challenges, institutions can enhance the quality of education, improve student learning outcomes, and better prepare graduates for the workforce.

Outcome Based Education in Engineering Education

Accreditation of engineering programs in nations that have ratified the Washington Accord is contingent upon using an outcome-based approach, which has been mandated by law in this area. The Washington

Accord is a consensus among the signatory nations about the criteria and standards for engineering programs. In 2013, Malaysia joined the Washington Accord's provisional membership alongside the US, UK, AU, NZ, IE, CA, SINGAPORE, RUSSIA, SOUTH AFRICA, HK, KOR, JAPAN, TAIWAN, and TURKEY. Consequently, Malaysia must guarantee that its engineering graduates are of equal quality to those of other nations if it wants to meet the internationally acknowledged standard for engineering education. Both public and private colleges in Malaysia offer engineering programs that are overseen by the Engineering Accreditation Council (EAC) Malaysia. The accreditation procedure is regulated by this body. As per the agreed-upon standards and prerequisites, it is expected that engineering program graduates will possess a set of competencies described by the Accreditation Board for Engineering and Technology (ABET) as Engineering Criteria 2000 (EC2000). According to the EAC Programme Accreditation Manual 2012, there are twelve Program Outcomes (PO) that define EC2000-level competence in the following areas: knowledge, conduct, and skill:

a) Capability to use knowledge of mathematics, physics, and engineering basics, as well as a specialisation in engineering, to the process of solving difficult engineering issues;

b) The ability to recognise, formulate, and investigate literature, as well as the ability to analyse complicated engineering issues and arrive at conclusions that are supported by evidence, employing the fundamental principles of mathematics, natural sciences, and engineering sciences;

c) Ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations;

d) The capacity to perform investigations into difficult issues by utilising research-based knowledge and research methodologies, such as the design of experiments, the analysis and interpretation of data, and the synthesis of information in order to arrive at accurate findings;

e) Ability to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations;

f) The ability to use reasoning that is guided by contextual information in order to evaluate societal, health, safety, legal, and cultural challenges, as well as the obligations that are therefore pertinent to professional engineering practice;

g) Capability to comprehend the influence that professional engineering solutions have on social and environmental surroundings, as well as the ability to exhibit understanding of sustainable development and the necessity of its implementation;

h) The capacity to apply ethical concepts and to make a commitment to professional ethics, obligations, and the generally accepted standards of engineering practice

i) Capability to communicate successfully with the technical community and with society in general on complicated engineering tasks, including the ability to read and create effective reports and design

documentation, the ability to make effective presentations, and the ability to provide and receive clear instructions;

j) Capability to perform well as an individual, as a member of varied teams, and as a leader in situations that involve many disciplines;

k) To be able to see the need for, as well as to have the preparedness and the capacity to participate in autonomous and lifelong learning within the broadest framework of technological change;

l) Capability to demonstrate knowledge and comprehension of engineering and management concepts, as well as the ability to apply these ideas to one's own work, acting as a member and leader of a team, managing projects, and working in environments that involve several disciplines;

Take note of the fact that engineering program graduates are expected to provide proof of having accomplished all twelve program outcomes when they graduate. This is a sign of an outcome-based strategy in action. Program Educational Objectives (PEO) are a set of twelve goals that students are expected to achieve between three to five years of finishing a program. These goals should guide and connect the twelve PO. Local government, industry, alumni, employers, advisory panels, students, and parents are among the external and internal stakeholders whose input is considered in constructing the program's PEO. In order to ensure that students take on a more challenging and complex environment with confidence, the outcome-based education method will be used throughout the whole curriculum. According to Dudman and Wearne (2005), technical proficiency is just one aspect of an engineer's job. Leadership, teamwork, and project management are just a few of the many managerial abilities that are encompassed. The ability to work in multicultural and multinational situations is a key competency for engineers looking to expand their careers globally. Companies seek for individuals with excellent analytical, logical, and communicative skills who can link fresh ideas in a collaborative environment (Baillie and Fitzgerald, 2000).

Issues and Challenges in Implementing OBE

The main challenge to effectively implementing outcome-based education is narrowing the meaning of outcome-based education. Success in a course is dependent on achieving its learning objectives (LO), which are prominently featured in this context. The usual practice for academic programmers is to further map the course LO to the PO so they can observe how much LO contributes to the achievement of PO. This is done to make sure that the course outline is being linked to the powerpoint. Table 1 shows the course LO-PO mappings, which show the correlational link. Many questions remain about how best to implement an OBE curriculum as the notion of OBE does not dictate a specific procedure or adherence to a single principle to achieve the intended outcomes. It was originally intended for online learning environments (OBE) to have a cycle of continuous development that includes regularly updating learning and teaching pedagogies, delivery methods, and evaluation procedures. Moreover, when it comes to creating course-specific learning outcomes, the ambiguity is even worse.

METHODS

As part of a larger study on the necessary shift to OBE learning in Mechatronic Systems Engineering, thirteen out of fourteen full-time faculty members were questioned. Teaching philosophy, practice, and

experience were the foci of the interviews. To make sure that all of the professors could understand and participate in the interviews, we utilised very little educational pedagogical theory and terminology. The faculty members were invited to participate in the interviews over email. After consulting with the MSE Department Chair, Simon Fraser University's Office of Research Ethics approved the study's execution. The following questions were put to teachers to help us understand their current pedagogical approaches and ideologies more thoroughly:

1. So, what exactly is it that you instruct people in?
2. As a teacher, what are your goals?
3. Step: how do you plan to achieve your goals?
4. What is the best way to describe the way you engage with students? When we talk about those exchanges, what do you do?
5. How are your pupils expected to perform in class?
6. In your opinion, what are the most important traits for students to have in the 21st century?
7. What steps can you take as an educator to support such traits?
8. Is there anything you could do differently as a teacher?
9. What is stopping you from implementing those changes?

Not only were the interviews recorded on video and transcribed, but they were also carried out in a manner that ensured the participants' anonymity. Following the conclusion of the interviews, the findings were compiled in order to investigate the recurrent topics that were discussed by the academics. Within the context of the current academic framework, the major focus of the collection of data was on the challenges that were identified by members of the faculty in terms of fostering student learning and achieving an outcome-based approach.

RESULTS

In their comments, the academics in the MSE department painted a detailed picture of the challenges they face every day in the classroom. Class size, grading practices, student motivation, and the gap between assumptions and reality regarding learner characteristics were named as the most common challenges. Furthermore, the characteristics and perceived role of the instructor were investigated, and it was usually discovered that these components clashed with the OBE model of learning. The most common issue that faculty members found was managing large (and increasing) class sizes, which varied from sixty to one hundred and eighty pupils. The necessity to interact and connect with students, coupled with limited resources, was the most formidable obstacle in large-scale classes. Teachers said they used a wide range of tactics to quickly become friends with their pupils. Among these methods were the following: taking or collecting pictures of students at the start of class and learning their names; sending individual emails to those who were absent; promoting question-and-answer sessions; and providing a safe environment where students could share their ideas while still feeling valued. Additional difficulties stemming from large class

sizes include insufficient numbers of teaching assistants and a lack of time to personally assist each student with their coursework. In their pursuit of "trying to find out how it can reasonably best work for a big class," every single teacher expressed a strong desire to become better educators and learn more about different pedagogical approaches that pique students' interest in learning. Three teachers visited Simon Fraser University's (SFU) Teaching and Learning Centre for advice, one took part in a course redesign workshop, and one sought the opinion of an outside expert on classroom dynamics based on his observations. Discord exists between the ideal traits that society expects pupils to possess in the twenty-first century and those that are really prevalent. Educators have seen this as the second challenge. According to the teachers, today's students are known for many things: being able to quickly adjust to new situations, taking responsibility of their own education, being able to process massive amounts of data (what one teacher called a "tsunami of information"), being imaginative and resourceful, curious about "why they need it" and "how to do it," taking risks, questioning authority, and having a "multidisciplinary sense" of the field they'll be working in. Teachers are worried that their current pupils lack the flexibility to adapt to new situations and the imagination to think beyond the box, two qualities that will be crucial for students in the modern world. In answer to a question on what qualities pupils should have to thrive in the modern world, one teacher provided an example:

> "These are the kids of the twenty-first century, aren't they? I challenged them to solve a mathematical equation. Their current strategy, which has been in place for the past three days, involves reading hundreds of papers in an effort to "Google" the problem and find a solution. If they had bothered to take the time, they could have fixed the situation. That aside, they used that time to try to figure out what was wrong and how to fix it. They aren't interested in finding a solution themselves, but in seeing problems resolved."

Teachers have reported that most students would prefer to sit back and take it easy when learning than to be an active participant in their own education. Dissatisfaction with the lesson plan could arise when students' expectations differ from those of the instructor. According to one instructor, the current system of evaluation has the ability to dishearten and discourage educators, which in turn causes them to use methods of instruction that are static and never up to par. One educator gave the following account when asked to characterise the current pattern of student conduct in the classroom:

> "It is vital to remember that facilitating is distinct from teaching, despite the widespread perception that this is the teacher's job description. Because students sometimes see instruction as a one-way street, it's critical that they realise that, yes, they are expected to actively engage in class, not just sit back and watch. This is in stark contrast to the typical movie-going experience, when one lies down, enjoys themselves passively, and then, upon leaving the theatre, merely summarises the narrative in a single statement. Contrarily, learning is not only summarising; it is the process of changing one's conduct. "

Instructors' comments also showed concern that OBE's promotional efforts would not align with their own priorities in the classroom. Most educators said that sharing information with students was the most important part of their job. This objective was expressed in several ways, including "covering basics and basic content," "instilling and delivering" the understanding, "transmitting the information," and "conveying knowledge. Finally, instructors ranked student motivation as the most critical factor in maintaining

classroom engagement. Students in their third and fourth years, who are known to be more focused, are easier to encourage than those in their first two years, according to their findings:

> "In most situations, fourth-year students have a great desire to acquire information in that particular topic, therefore connecting and communicating with them is not too tough for me. The second year brings a new change. They are powerless to avoid showing up since it is mandatory. When first- and second-year students find the course illuminating and when real-world engineering problems are shown to them, it motivates them to keep studying."

DISCUSSION

In this paper, we voice our concerns from a pedagogical standpoint on various approaches to learning outcomes. In this article, we reviewed the history of organisational behaviour evaluation (OBE) models and their applications in the classroom. Using faculty responses to questions about their pedagogical perspective, this article takes a close look at the pedagogical factors that went into revamping the present curriculum. Although there has been a lot of study on the learning benefit and student responsiveness to OBE techniques, very little is known about the faculty members who are responsible for implementing them, particularly when changes that are necessary from the outside. In order to facilitate the transition to OBE techniques among engineering professors in Canada, this initiative will provide the framework for effective and efficient approaches. In the poll, professors at MSE raised a number of concerns regarding the implementation of OBE strategies and their impact on improving the student experience. The most common concern was the number of students in each class. The MSE program at SFU, like many others in the engineering field, has rather high class sizes. There has been a lot of research on strategies for effectively directing student bodies that are increasingly diverse. Killen argues that overcrowded classes may be successfully split, and that the most important thing is not the amount of time students spend in class but the quality of their learning. Having well-defined goals and expectations for student learning may inspire them to look beyond the box in the future. By posing pertinent questions and outlining suitable objectives, educators have the power to elevate their students' learning experience, equipping them for academic and personal success. Teachers may help students become better learners by encouraging the concept of context-specific best practices rather than emphasising on right and wrong answers. A combination of direct and "student-centered" methods of instruction, ample opportunities for students to apply what they've learnt, and guiding them to personal closure at the end of each learning episode to demonstrate the future are all necessary, according to Killen, for students to learn effectively. By asking oneself, "What do I need to learn?" educators might better understand their students' perspectives. So why do I have to learn it? What precisely am I going to accomplish when I am studying? How interesting and useful is it going to be? How can I be sure that I am learning everything I need to? Am I able to choose how my education unfolds? Exactly how are they going to evaluate me? A number of educators expressed worry that their pupils were not making an effort or showing any interest in class. When asked to define their job as educators, the majority of teachers held to the tried-and-true paradigm of imparting knowledge in a linear way, even if they acknowledged that students needed to be more involved in their own learning.

CONCLUSION

The adoption of Outcome-Based Education (OBE) in engineering education presents a transformative

opportunity to enhance the quality and relevance of academic programs. By focusing on measurable learning outcomes, OBE ensures that graduates acquire the necessary skills and competencies required by industries and global accreditation bodies. However, its successful implementation is hindered by several challenges, including faculty resistance, lack of adequate training, ineffective assessment methods, and institutional constraints. To overcome these barriers, institutions must invest in structured faculty development programs, adopt robust assessment frameworks, integrate industry collaboration, and leverage technology for continuous monitoring and evaluation. A collective effort from educators, administrators, policymakers, and industry stakeholders is essential to creating an ecosystem that fosters the smooth transition to OBE.

By addressing these challenges proactively, engineering institutions can not only improve their educational frameworks but also produce graduates who are well-prepared for the evolving demands of the global workforce. Moving forward, further research and case studies on best practices for OBE implementation can provide deeper insights into optimizing its effectiveness across diverse educational environments.

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