RUBRICS

PROBLEM ANALYSIS

Dr. J. Raja Murugadoss & Dr. R. Priya Vaijayanthi

This book seeks to offer a comprehensive insight into the multidisciplinary educational approach rooted in a profound passion for and mastery of knowledge in the field of outcome-based education. It is published with a personal commitment to disseminate the genuine essence of outcome-based education via rubricsedu.com. While there is an abundance of articles, research literature, and various forms of information available on the topic of problem analysis, one of the student learning outcomes, this work endeavours to shed light on the subject by providing a few classical examples. Gratitude is extended to a higher power for this opportunity and also we would like to acknowledge the support being provided by the Management of Nadimpalli Satyanarayana Raju Institute of Technology (NSRIT), Visakhapatnam, AP.

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Typical example for problem analysis

In this inaugural narrative, illustrated through an actual occurrence, the author endeavors to captivate your focus concerning the subject of "Problem Analysis." It is anticipated that this exploration, centered on a modest yet profound technical facet of Mechanical Engineering, will not only be intellectually stimulating but also offer a source of inspiration and enlightenment. Source: **marketcalls.in**

The Pontiac Division of General Motors received a grievance that reads as follows: "I find it pertinent to bring to your attention that this marks the second time I am addressing you. I do not hold you responsible for my previous lack of response, for my previous communication may have seemed peculiar. However, I wish to highlight a peculiar family tradition in our household that revolves around dessert after our evening meals. Specifically, this tradition entails selecting a different type of ice cream each night, followed by a family vote to decide the evening's flavor. Subsequently, I embark on a drive to the store to procure the chosen variety. It is also worth noting that I recently acquired a new Pontiac vehicle, and this acquisition has inadvertently given rise to an issue during my routine store trips."The Pontiac Division of General Motors received a grievance that reads as follows: "I find it pertinent to bring to your attention that this marks the second time I am addressing you.

PART ONE

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PART ONE

Typical example for problem analysis

The President of Pontiac understandably approached this letter with skepticism; nonetheless, he authorized the dispatch of an engineer to investigate the matter. he engineer was taken aback when he was welcomed by a prosperous and evidently highly educated individual residing in an upscale locality. Their meeting had been scheduled just after dinner, and the two of them promptly entered the vehicle and headed to the ice cream parlor. On that particular evening, they opted for vanilla ice cream, and as anticipated, upon their return to the car, it refused to start.

The engineer conducted further investigations on three subsequent nights. On the first occasion, they selected chocolate ice cream, and the vehicle initiated without any issues. The second night, strawberry ice cream was chosen, and the car started up flawlessly. However, on the third night, vanilla ice cream was once again requested, and regrettably, the car remained inoperative. Given his logical disposition, the engineer was unwilling to accept the notion that the gentleman's vehicle had an aversion to vanilla ice cream. Consequently, he committed to persist in his visits until the enigma was unraveled.

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Typical example for problem analysis

With this objective in mind, he initiated a systematic record-keeping process, meticulously documenting a wide range of variables, including the time of day, the type of gasoline used, and the duration of the round trips, among other pertinent data.

In a brief span, he unearthed a significant clue: the purchase of vanilla ice cream required less time compared to other flavors. The key to this puzzle lay in the store's layout. Vanilla, being the most popular flavor, was conveniently displayed in a separate case at the front of the store, facilitating swift selection. In contrast, all the other flavors were situated at the rear counter, resulting in a more time-consuming checkout process.

The pressing question for the engineer now shifted from why the car failed to start with vanilla ice cream to why it wouldn't start when less time was taken. The revelation came swiftly – the culprit was not the vanilla ice cream but rather a phenomenon known as "vapor lock." This predicament occurred every night, but the additional time spent acquiring other flavors allowed the engine to cool down adequately, enabling it to overcome the vapor lock.

PART ONE

Typical example for problem analysis

Conversely, when the man obtained vanilla ice cream, the engine remained too hot for the vapor lock to dissipate, causing the starting problem.

This narrative compellingly underscores the significance of problem-solving, emphasizing that it extends beyond technical solutions. It underscores the importance of delving into a comprehensive understanding of diverse facets and adopting a multifaceted approach when seeking resolutions.

PART TWO

The Authentic Essence of Problem Analysis

Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. Source: NBA.

The importance of this particular student learning outcome is paramount within the context of outcome-based education (OBE), and it resonates with a fundamental principle embraced by the signatory nations of the Washington Accord. This principle revolves around the ability to effectively tackle complex engineering problems, an indispensable skill for engineers in today's world. In essence, it underscores the need for graduates to possess the capability to analyze intricate challenges and devise innovative solutions.

This outcome serves as the linchpin upon which the entire OBE framework hinges. It forms the nucleus around which all other learning outcomes revolve. These interconnected outcomes create a cohesive educational experience that extends beyond the mere accumulation of knowledge and theoretical understanding. They emphasize the practical application of acquired knowledge and the development of critical thinking, problem-solving, and adaptability skills.

PART TWO

The Authentic Essence of Problem Analysis

01

Primarily, learners should be adept at discerning the essence of the problem and comprehending the full scope of the issues at hand, akin to the example cited in Part One.

It involves identifying and framing these problems in a clear and meaningful manner, ensuring that they are relevant to the intended learning outcomes and goals of the educational program. And problem formulationmay must have a mathematical rigour, if required.

02

03

Learners are encouraged to cultivate a scholarly disposition that entails referencing research findings gleaned from technical research papers within the specific context of the prevailing problem. This practice aims to foster a profound comprehension of prior endeavors in analogous scenarios, thus promoting a deeper understanding of the subject matter.

Learners should instill a practice of methodically selecting an appropriate methodology, identifying the requisite tools and applications, and leveraging the wealth of information found in the existing literature. Through this systematic approach, they can derive scientifically substantiated conclusions

04

05

Eventually, the learners should provide a sustainable solution after validation with a strong base in STEM

PART TWO

The Authentic Essence of Problem Analysis

In the process of crafting the curriculum structure and its associated deliverables, curriculum designers, educators, subject matter experts (SMEs), or a collective of SMEs ought to contemplate the following facets to facilitate the cultivation of these desired learning outcomes among the learners.

- The curriculum should encompass pertinent educational materials designed to stimulate critical thinking and problem-solving, with a particular emphasis on bridging the gap between theoretical knowledge and real-world engineering challenges
- A prerequisite within the curriculum should involve the mastery of problem formulation methodologies. This encompasses the art of transforming intricate real-world issues, replete with complex variables, into precise mathematical expressions or, in certain instances, simulation models
- The curriculum should provide ample resources that empower students to explore scholarly articles and cultivate awareness of reputable academic journals, thus fostering a commitment to lifelong learning.

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PART TWO

The Authentic Essence of Problem Analysis

- The pedagogical approach should encourage students to tackle multifaceted challenges through collaborative efforts within diverse teams, where each member contributes a unique set of skills, thereby championing a multi-disciplinary educational ethos.
- Ultimately, learners should be afforded the opportunity to conduct testing and validation procedures grounded in STEM (Science, Technology, Engineering, and Mathematics) education principles.
- Lastly, course instructors should possess robust assessment tools capable of thoroughly evaluating and appraising these learning outcomes at each stage, while creating a supportive educational milieu conducive to nurturing these skills.

DO OUR CURRICULUM HAVE THIS FLAVOUR?

The primary lesson derived from this chapter underscores the imperative of attaining a comprehensive comprehension of the precise expectations pertaining to this particular outcome, encompassing both the fundamental essence of the desired outcome and the specific attributes that necessitate cultivation among graduates.

PART THREE

Present Scenario

Since 2014, there has been a significant emphasis on urging all Higher Education Institutions (HEIs) to adopt and embrace Outcome-Based Education (OBE) with the goal of elevating our educational model to meet global standards and gain acceptance on an international scale. In pursuit of this objective, various stakeholders, including statutory bodies, universities, HEIs, and subject matter experts well-versed in OBE, have been wholeheartedly investing their efforts to raise awareness about OBE among HEIs and provide continuous support to them. There is a unanimous consensus on the importance of this initiative.

Following the introduction of the National Education Policy in 2020, this effort has gained momentum, leading to a transformation of our traditional curriculum into an industry-integrated, outcome-based curriculum designed to enhance students' employability. Additionally, ongoing endeavors have been made to integrate skill-based courses alongside theoretical ones, enabling students to acquire not only knowledge but also the practical skills and character competencies outlined in the learning outcomes and aligned with the contemporary demands for 21st-century skills.

PART THREE

Present Scenario

Therefore, there is a pressing need for a comprehensive understanding of OBE in its true essence to bring about fundamental changes in curriculum delivery. This entails aligning with learning outcomes, selecting appropriate assessment tools, and establishing timelines for assessment and evaluation, all of which collectively drive the entire learning process.

"The current challenge lies in the diversification of perspectives on Outcome-Based Education (OBE) within various educational institutions. Each institution has developed its unique interpretations, replete with a plethora of assumptions, distinct approaches to implementation, individual methods for aligning courses with predetermined learning outcomes, and even the liberty to manipulate the prescribed statutory statements of learning outcomes to suit their specific requirements and convenience in attaining the anticipated Taggert Performance Level (TPL). This multifaceted landscape of OBE practices mirrors the concept of '**An age-old elixir, freshly ensconced within a novel vessel**. This is an extremely grave concern that demands attention at every echelon.

PART THREE

Present Scenario

Within the context of curriculum framework development, a lamentable issue arises when courses imbued with an analytical or problem-solving essence are hastily linked to the learning outcome "Problem Analysis" without undergoing a thorough immersion into the profound comprehension necessary to precisely ascertain its measurement criteria.

Subsequently, these courses are allotted distinct weightage, ranging from '3' to '2' or '1,' and assigned various color codes that are contingent on the level of contributions, degree of consistency, and the extent of relevance, thus forming the basis for their alignment. The mapping is pretty done based on a well defined justication proportional to the level of contribution that enables the students to nurture the intended qualities to raach the extended learning outcomes.

Turning our attention to a critical example, we can observe that courses such as 'Programming using the 'C' language' are linked to this specific outcome. It's worth noting that this course falls within the domain of Engineering Science, encompassing a significant portion of mathematical concepts and select technologies. Naturally, this course is designated with a weightage of '3'. The pivotal inquiry, therefore, is as follows:

PART THREE

Present Scenario

1. Do these kind of courses have scope for problem identification?
2. Do these courses have a scope for problem formulation?
3. Do these courses require any literature survey?
4. Do these courses require any sort of analysis and provide solutions based on STEM education

Probably, these courses may be useful to a vert great extent to code a complex engineering problem if required. So its just a pre-requisite modern tool similar to Python, Java or any othe programming languages. Now the question is What do we understand from this mapping? Are we in the right track? Are we implementing the true philosophy of OBE? Are we educating the tru OBE educationla pedagogy to the learners? Are we just doing for some statutory requirement? Are we just doing to claim that we are implementing OBE? It's a million dollar question. Have we ever thought of revisit our alignment? What to infer from this. Arguably, these courses could prove highly instrumental in tackling complex engineering challenges when the need arises. They function as essential prerequisites, much like Python, Java, or other programming languages. This raises the following pertinent questions: What can we glean from this alignment? Are we on the right course? Are we faithfully embodying the core tenets of Outcome-Based Education (OBE)?

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Are we truly imparting OBE's educational philosophy to our learners, or is this simply a compliance with statutory requirements? Are we merely going through the motions to claim OBE implementation? These questions are of profound significance. Should we not contemplate revisiting our alignment and discerning the implications of these observations? The authors express deep concern, given that numerous other courses are similarly aligned in this manner, yet the corresponding content is not thoughtfully crafted to effectively address the specified learning outcomes.

The courses that align with this learning outcome should encompass these elements, fostering holistic student development. When analytical courses are mapped without these dimensions, they may primarily focus on applying mathematical concepts, rather than nurturing problem-solving skills. In such instances, these courses are most suitable for achieving the learning outcome labeled 'Engineering Knowledge. In the course ‘C’ programming as cited above, when we loook into the content deliverables, it just talks about the grammer of ‘C’ programming languages and its application to solve few basic mathematical operations. To have a further deep understanding, let us look into the course outcomes of the course as cited above.

1. Showcase the problem-solving process by employing algorithms, pseudocode, and flowcharts.
2. Exhibit the utilization of conditional and iterative statements in programming by creating three distinct programs

PART THREE

Present Scenario

- Depict the application of arrays and strings
- Describe the usage of pointers and functions
- Comprehend and apply file manipulation functions to manage data files

Through a thorough analysis of the outcomes, it becomes evident that the courses are designed to cultivate fundamental language skills, primarily enabling students to perform basic mathematical operations like array addition. It is apparent that this approach falls short in adequately preparing learners and providing them with the practice needed to solve the complex engineering problems expected from graduates in this learning outcome.

PART THREE

Present Scenario

Furthermore, and perhaps most crucially, this approach fails to foster higher-order thinking skills and creativity, which are integral aspects of the pedagogy of outcome-based education. Therefore, it is imperative to recognise the pressing need for alignment between our current understanding and the actual expectations of what the learning outcomes aim to nurture..

> Hope this example clearly enables to underscore the necessity for a more profound comprehension of OBE in its genuine essence. Let us unite in our efforts to enhance our educational standards, aligning with the expectations of the statutory bodies.

PART FOUR

Major Challenges & Definition of Complex Engineering Problem

- Lack of the true knowledge of OBE in the way it is being expected
- Wrong interpretation of the transactional statements of graduate attributes
- Different styles of implementation with our own understanding and interpretation
- No alignment between curriculum, teaching - learning methodologies, identification of assessment tools and evaluation
- Lack of understanding of RBT and its implementation
- Lack of rigorous review mechanism leading to continuous improvement
- No proper strategic formulation to address the reduced level of attainment of learning outcomes
- Lack of competency over credentials
- Lack of understanding leading to inaccurate data that further leads to non-compliances

THE ENTIRE CRUX OF THE OUTCOME BASED EDUCATION

SOLVING COMPLEX ENGINEERING PROBLEMS

Creating Prolem Solving Graduate

WITH

CONTINUOUS IMPROVEMENT

by aligning Learning Outcomes, teaching & learning activities and the assessment (Biggs 2003)

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PART FOUR

Major Challenges & Definition of Complex Engineering Problem

- Cannot be resolved without in-depth engineering knowledge.
- Involve wide-ranging or conflicting technical, engineering and other issues.
- Have no obvious solution and require abstract thinking and originality in analysis to formulate suitable models.
- Involve infrequently encountered issues.
- Outside problems encompassed by standards and codes of practice for professional engineering.
- Involve diverse groups of stakeholders with widely varying needs.
- High level problems including many component parts or sub-problems

Ref. : As per Washington Accord (IEA 2015)

Example for a complex engineering problem (indicative): A popular river in a particular city flowing through several residential areas in Chennai, Tamil Nadu. You are a consultant appointed to propose a river restoration action plan for a part of the river beginning from the upstream until the midstream say 'X'. Your proposal should include action plans to accomplish the following objectives. mproving the water quality of Cooum to Class II and III

- Prevention of direct solid waste discharge into the river system
- Creating suitable habitats for the propogation aquatic life
- Adding property and aesthetic value to residents living along the river

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THE FIRST

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