Effectiveness of Curriculum Design in the Context of Outcome Based Education (OBE)

Priya Vaijayanthi R., Raja Murugadoss J.

Abstract: Outcome Based Education (OBE) is now a days becoming a mandate in almost all higher educational institutions across the country as it turned out to be an authorized signatory member of Washington Accord (WA) in 2014 through the National Board of Accreditation (NBA). The fundamental concept of outcome-based education is to ensure continuous improvement at all levels of teaching – learning – assessment process. Though there are several programmes were organized to build the competency of OBE, the present traces of implementation of OBE in educational institutions clearly demonstrate the lack of understanding the real implementation of OBE and strictly it is a serious concern. Even these traces are observed in the programs, which are accredited. In the present paper, an attempt has been made to enable the stakeholders to truly understand some of the basic elements of OBE, which will really help them to deploy the philosophy of OBE in the way it is expected for continuous improvement.

Index Terms: outcome based education; curriculum design

I. INTRODUCTION

The Curriculum Design, Delivery and Assessment [1], [2], [3] are the three predominant pillars of engineering education and the former one sets the base for all other subsequent processes of OBE. Moreover curriculum design is one of the ever challenging and crucial tasks in the entire process at all times. The curriculum designers need to understand the real meaning and significance of the statements of Program Educational Objectives (PEOs), Program Outcomes (POs) and Course Outcomes (COs) while formulating the curriculum. In this paper, the curriculum of fifty prominent colleges having the status of autonomy is taken as a vehicle to understand the effectiveness of the statements of PEOs, POs [4], [5], Program Specific Outcomes (PSOs), COs or Instructional Outcomes (IOs) and Program Specific Criteria [6] of their respective Lead Society which enable the curriculum designers to have sound formulation of the curriculum.In most of the curriculum which were taken to understand the effectiveness of the curriculum design, it is observed that the PEOs itself are very uncertain and does not reflect any kind of Professional and Career Accomplishment over a period of four to five years after graduation, as per the definition of statutory bodies. Hence meticulous care is always needed capturing the voice of all possible internal and external stakeholders while formulating the PEOs. The stakeholders include Management, Academicians, Professional Bodies, Research Organizations, Parents, and Industries, Alumni and so on so forth. *PEOs are taken at the first instance to understand as it fixes the objectives of the entire program "What the Graduates will be after four to five years of Graduation".*

Here are few examples of PEOs

Example No. 1: Design and develop electronic circuits and systems, based on the existing as well as emerging technologies

Example No. 2: Graduates will have the fundamental knowledge of mathematics, science, economics and computing and in-depth knowledge in Civil Engineering concepts through theoretical, laboratory and project-based experiences so as to design, develop and solve engineering problems.

Example No. 3: Analyse, solve, design and execute projects with the fundamental knowledge of Civil Engineering

In all examples, careful examination of the statements of PEOs as cited above, it is found that there is no reflection of either Professional or Career Accomplishments to the authors understanding as well as by the definition of PEOs. For instance, in Example 2, it is evident that Graduates "will have the fundamental knowledge" only after 4 – 5 years of graduation. Is it what expected with PEOs? The answer is absolutely No. The concern here is that, if the PEOs itself are not clearly formulated and defined, then

   a. *What about the effectiveness of formulating the Program Outcomes?*
   b. *What about the effectiveness of formulating Course Outcomes?*
   c. *What about the effectiveness of mapping of COs with POs?*

If all the above threats are not addressed and implemented properly, the concept of Outcome Based Education will have its natural expiry over a period of time in a country like India, where the number of engineering graduates is more predominant. Hence in the present paper, an effort has been made to demonstrate the structured mechanism of curriculum design and other essential elements that are needed to formulate the curriculum.

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2. Curriculum Design

As already discussed in the earlier section, the curriculum design is an issue in all seasons. It is important to understand that the issues involved in curriculum are, for every generation and it's all about controversy and dispute.

The deliverables of the curriculum should always be the matters of argument and discussion leading to cafeteria model or skill/competency based curriculum. Recently the phrase, the "Curriculum Design" is prefixed with another phrase "Outcome Based" leading to more complex giving a look of education as a democracy. At present, the OBE is with different versions, with different ideas and with different implementation procedures with different understating at different places but comes out with a single label of Outcome Based Education. The South Australian SACSA (*South Australian Curriculum Standards And Accountability*) framework says, "The final common aspect of the SACSA Framework lies in its approach to learner assessment. This approach comes from the tradition of outcomes-based education. This tradition is based on the belief that the curriculum process should begin with the explicit statement of the outcomes expected and that curriculum content, processes, structures and resources should be planned to expand children's and students' opportunities to achieve the outcomes". Now, NBA also comes up comes up with a set of broad learning outcomes that enable the curriculum to nurture skills, knowledge, behavior, values and attitudes in accordance with WA, which are more essential for graduates to demonstrate their learning outcomes to become a responsible citizen as an engineer. Accordingly all the educational programs formulated their own of PEOs, POs and COs with their own understanding and few examples are cited in earlier section. Hence there is strong necessity of understanding some of the basic terminologies in true sense to deploy OBE in the way it is expected. In the present paper, an appropriate tested framework is proposed to formulate a sound curriculum.
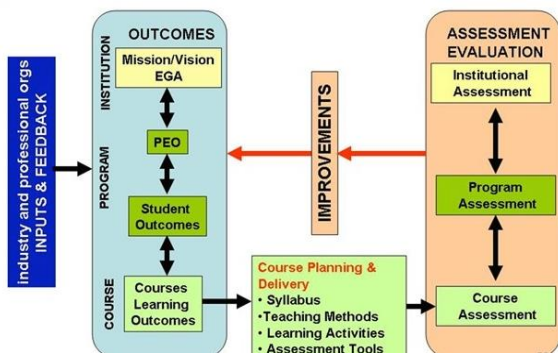

Figure 1 Procedure for Curriculum Design

2.1 Procedure for Formulating Program Educational Objectives (PEOs)

In line with Figure 1, the following steps may be adopted to arrive a sound curriculum to make the students professionally and ethically competent among their peer group. Here, the program of CSE/Civil Engineering is taken as an example to brief the step-by-step procedure of the proposed model.

Step 1: Capture the voice of the relevant and allied stakeholders viz. IT industries that are predominantly focusing on various aspects of Computer Science and Engineering viz. Programming, Database and Database Management, Storage, Web Technologies, Software Testing, App Development, Network and Network Security and other related contemporary technologies Most importantly, the feedbacks, which are likely to be received from stakeholders, should be in the documented form to understand the demand drive needs of industries over a period of time

Step 2: Understand the expectations of the Management through the Vision and Mission of the Institute and there may be several other ways to explore

Step 3: List out expectations of the internal stakeholders among the members of faculty related to the program

Step 4: Understand the Program Specific Criteria of the Program Lead Society. Here it is ACM, IEEE for CSE and ASCE for Civil Engineering

Step 5: Collate all the needs of the stakeholders and brainstorm among internal stakeholders to formulate the initial draft version of the PEOs

Step 6: Circulate the PEOs among all potential stakeholders and record the feedbacks to arrive a final version of the PEOs, which in turn provide a clear vision to the curriculum designers

Most importantly, the curriculum designed should doubly ensure that the proposed statements of PEOs must reflect the Career and Professional accomplishments of the graduates. And the PEOs can be redefined once the attainment values sustain on the target performance level over a period of time, say 5 – 6 years. Further there is no restriction on the number of statements of PEOs; however it is recommended to restrict to maximum of three, which are Specific, Measurable, Attainable, Realistic and Time bound (SMART).

2.2 Procedure for Formulating Program Outcomes (POs)

Based on the PEOs, the curriculum designers can formulate the graduate attributes (GAs) (Figure 2) according to their requirement and which can be transformed to measurable Program Outcomes (POs). POs are the transactional statements of GAs, which are normally measured at the end of the program of study. Further, NBA has prescribed certain number of GAs that can be categorized in three major dimensions viz. Knowledge, Skill and Behavior, which is universally acceptable to all programs and in turn it is in line with WA as follows.

Figure 2 Graduate Attributes

Based on the graduate attributes, NBA has also defined the statements for Program Outcomes, which can be slightly modified to match the requirement of the respective engineering programs. *Here the problem starts with the understanding of the POs.* Lets take an example of the PO pertaining to the graduate attribute, Design and Development of Solutions. It says,

"Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations"

The above statement clearly defines that the student should demonstrate the following elements viz. Design Solutions for complex problems; Design System or components or processes that meets certain constraints depending on the nature of the problem. Also it is observed that the following courses are mapped to this particular PO i.e. Design and Development of Solutions. The mappings are taken from those curricula pertaining to those educational institutions as discussed earlier, which are taken as a vehicle for understanding.

- 'C' Programming
- Java Programming
- Computer Programming
- Engineering Mechanics
- Surveying
- Data Structures
- Artificial Intelligence
- Environmental Studies
- Basic Electrical Engineering
- Computer Organization and Architecture

After having necessary careful examination of the deliverables of the above courses, surprisingly it is observed, that there is no such traces of deliverables i.e. classroom transaction available in the syllabus and there are no relevant contents available that either directly or indirectly in the syllabus to enable the students to demonstrate or to perform the following activities like the design a solution, system, components or processes at the end of the course. This inappropriate mapping clearly demonstrates the lack of understanding of terminologies involved in the statements of the POs as well as the process of mapping of courses to each and every POs. Not only for this particular PO, it is observed in almost all POs.

Another best example with another PO is "Individual and Team Work". Here the PO says,

"Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings"

The statement very clearly defines that graduate would able to work independently as an individual or as one of the members in a group or as a leader in a diversified environment or in *a multidisciplinary settings.* As cited in earlier examples, the courses like laboratory courses in their respective core branch of engineering, project works of similar discipline, term paper are mapped.

In fact, the true meaning of the statement of PO is as follows. The program should prepare the graduates by providing adequate practical exposure to the students to understand his/her responsibility as an engineer either as an individual or as a member of a team or as a Leader of a team to function effectively in a diversified and multidisciplinary environment.

The above statement clearly defines the learning outcome of this particular PO that a graduate need to demonstrate at the end of the program. On the other hand, the courses which are mapped as cited above has no relevance to enable the students to feel the diversified environment as well as to understand his/her role either as an individual/in a team/as a leader. This inappropriate mapping again reinforces the curriculum designers' lack of understanding that lead to the formulation of weak curriculum. On the other hand the curriculum designers would have identified courses like interdisciplinary projects, internship at industries where the students will be exposed to different diversity and culture. Therefore, it strongly necessitates the need of understanding of mapping process too for the real implementation of OBE and clearly evident that is a complete lack of understanding on the basic elements of POs and the mapping of courses.

2.3 Procedure for Identifying the Courses

Once the PEOs and POs are properly stated, the curriculum designers along with the team of internal experts and with the help of other stakeholders who have really experienced the curriculum can organize a brain storming session to identify the list of courses alone and not the syllabus considering the various facets of POs. Here, one important aspect to be noted is that the title of the course should not brand any name or a software name or a name of programming language. Instead it can be named appropriately. The courses should a good coverage of all the three baskets of GAs, which are in the form of POs. The proportion of courses may be kept similar to the norms prescribed to statutory bodies with marginal variation. However the deliverables plays a critical role in achieving the learning outcomes.

2.4 Procedure for Formulating Course Outcomes (COs)

As you aware that COs, are normally measured at the end of the course. At present there are different versions, dispute and controversy prevailing with regard to the number of COs to be kept for each course.

For example, one school of thought reflects that the number of COs must be equal to the number of units in that particular course. There is another school of thought that they insist to keep the number of COs equal to the number of cognitive levels of Revised Bloom's Taxonomy (RBT). As already discussed, it is again looking like a democracy with their own understanding, ideas, practices but all comes with a label of OBE.

The main problem of all these ambiguity or difference in understanding is due to the formulation of syllabus at the first instance and in reverse engineering, the course outcomes are formulated. But truly speaking, this problem of conflict can be avoided with the following steps.

   a. Formulate the course outcomes to fix the breadth and depth of a particular course. Here the curriculum designer can have the liberty to formulate any number of COs that is actually required to enable the students what the instructor is intended to make the students to do at the end of the courses.

However it is suggested to restrict to a limited number of COs, that can be manageable

b. Secondly, according to the COs, the deliverables can be formulated with meticulous care and effort by taking necessary inputs from all possible stakeholders in a documented procedure

If the above steps are followed without any deviation, it is certain, that all the COs and POs will in the same alignment reflecting the true essence of OBE. The word "true essence" is often repeated in this paper because it is serious concern that needs to be addressed without any delay or else as suggested it will have its natural expiry and it will set bad examples of executing the process of OBE. This is the main concern here.

The flipside of this process is that, to what percentages of the deliverables in a course as well as the number of courses to be populated so that the students have adequate exposure during the four years of engineering education matters a lot. Having couple of courses in a particular semester or couple of higher semesters may not give the real taste to students to demonstrate any particular learning outcomes. It is always suggested to spread certain components in the semesters wherever possible to maintain the rigor of the POs or COs, so that the learners will have continuous grip on any particular PO through out entire program of study.

2.5 Summary of Curriculum Design

In this section, the curriculum design [7], [8] is explained with a schematic diagram (Figure 3) for a better understating of the readers.

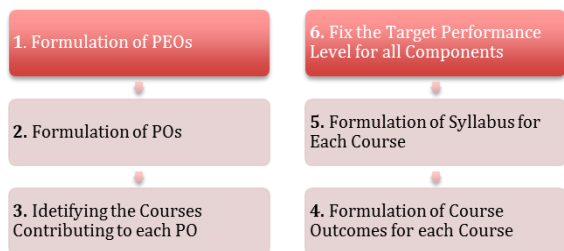| 1. Formulation of PEOs	6. Fix the Target Performance Level for all Components
2. Formulation of POs	5. Formulation of Syllabus for Each Course
3. Idetifying the Courses Contributing to each PO	4. Formulation of Course Outcomes for each Course

Figure 3 Procedures for Curriculum Design

Here, the target performance level, shall be fixed depending on the age of the program, track history and expertize available in the program. However it can be taken as a guideline for designers and they can take the liberty in fixing the target performance level.

II. CONCLUSION

This paper presents an overview of the some of the essential characteristics of outcome based education in the context of the process of formulation of program educational objectives, program outcomes, course outcomes, identification of course titles and finally summarizes the overall framework of curriculum design. From the examples, it is evident that there is serious lack of understanding on outcome-based education among the stakeholders who are predominantly responsible for implementation. At present, OBE is deployed in different forms with varied styles of interpretation, which is absolutely not inline with the way it is expected. Hence, it is recommended to adhere to the guidelines as suggested by the authors to formulate a sound curriculum that meets the expectations of the program of study.

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