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Developing a knowledge structure using Outcome based Education in Power Electronics Engineering

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Abstract

Outcome based education (OBE) is student-centered instruction model that stresses on judging student performance through outcomes. Outcomes include knowledge, skills and behavior. Outcome-Based Education model is being adopted at a fast pace at Technical institutions all over the world. It is considered as a massive leap forward to convalesce technical education and help Engineers compete with their global counterparts. OBE gives more weightage on what the students will be able to 'do instead of what they will 'know'. Hence it is important to develop the instructional model to improve knowledge, skill, behaviour of the students. Knowledge structure is the micro level component and the part of the course outcome which will enable the student to gain the confidence of 'doing' instead of 'knowing'. This paper proposes an Instructional Model by developing a knowledge structure in Power Electronics Engineering.

Keywords: Outcome based Education ; Programme Educational Objective; Programme Outcome; Course Outcome; Interdisciplinary Core Logics;

1.0 Introduction

An OBE curriculum starts with a clear picture of what is vital for students to be able to do, then organizing the curriculum, instruction and assessment to make sure this learning ultimately happens. The four basic principles are[7] .

1.1. Clarity of focus

Teachers must clearly focus on what they want students to know, understand and be able to do. Teachers should focus on helping students to develop the knowledge, skills and behaviour that will enable them to achieve the intended outcomes as clearly articulated.

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1.2. Designing down

The curriculum design must start with a clear description of the intended outcomes that students are to achieve by the end of the program. Once this has been done, all instructional decisions are then made to ensure achieve this desired end result.

1.3. High expectations

Teachers should establish high standards of performance in order to encourage students to engage deeply in what they are learning. Helping students to achieve high standards is linked very closely with the idea that successful learning promotes more effective learning.

1.4. Expanded opportunities

Teachers must try to provide expanded opportunities for every student. This principle is based on the idea that not all learners can learn the similar thing in the similar time and in the similar way. However, almost all the students can attain higher standards if they are given correct opportunities.

2.0 Components of Outcome based Education

The main components of OBE are:

- Vision
- Mission
- Programme Educational Objective
- Programme Outcome
- Course Outcome
- Knowledge structure

2.1 Vision:

A vision statement is a statement of an Institution's predominant aspirations of what it expects to become or to achieve. It explains what an Institution targets to achieve in the long-run, generally in a time frame of three to seven years. It sets a defined direction for planning and execution of strategies and how the Institution will look like in the future[1]. It should be a more striking, concise statement which is to be known to each and every one of the institute from the top to the bottom level.
The Vision statement is defined by the Chairperson who is going to institute the Institute with Policy Makers, Local Employers, Industry, Alumni and the Local Community.

2.2 Mission:

The mission statement depicts the necessary steps to achieve the vision. The mission and vision statements must support each other, but the mission statement is more specific. A mission is different from a vision in that the mission is the cause and the vision is the effect; a mission is something to be accomplished whereas a vision is something to be pursued for that accomplishment.

2.3 PEO: Programme Educational Objective:

Program Educational Objectives (PEO) are wide statements that define the expected attainment of graduates to within few years of graduation. According to the need of the Program's constituencies, Program educational objectives are designed. The educational objectives of an engineering degree program are the statements that

describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation.

2.4 Programme Outcome:

POs are statements about the knowledge, skills and behaviour, the graduate of a formal engineering program should have. POs deal with the general aspect of graduation for a particular program, and the competencies and expertise a graduate will possess after completion of the program[2].
These are broad and covers a wider area than of Course Outcomes. The NBA has set twelve Program Outcomes, or Graduate Attributes for the sake of unity and quality assurance.

Graduate Attributes related to core knowledge:

- Engineering knowledge
- Problem analysis
- Design/development of solutions
- Conduct investigations of complex problems

Graduate Attributes related to Skills:

- Modern tool usage
- Environment and sustainability:
- Communication
- Project management and finance

Graduate Attributes related to behaviour

- Ethics
- The engineer and society
- Individual and team work
- Lifelong learning[3][4]

OBE insists that graduate should attain the twelve attributes with minimum threshold level at the end of the programme. To attain these graduate attributes, it is important to infuse these attributes during teaching. For example, teaching ethics or environment alone is not OBE. These skills and behaviour attributes should be infused with the core knowledge during teaching. Developing the Instructional model to infuse skills and behaviour attributes with the core knowledge is important. The attributes infused in the content delivery is called course outcome which will measure and map the COs and POs[5]. This paper proposes how the graduate attributes are infused in the content delivery.

2.5 Course Outcomes (COs)

POs are attained through program specific Core Courses, which has their own previously set outcomes to attain. These course-specific outcomes are called Course Outcomes or Course Learning Outcomes. Each course is designed to meet the Course Outcomes (normally 5-6; but not mandatory). The Course Outcomes are stated in such a way that they can be actually measured[6]. Normally the COs will be constructed by the knowledge structure which is a piece if Course Outcome. Knowledge structures will be delivered in the episodic way; normally 10-15 min for each episodic delivery; Accumulated knowledge structure/episodic delivery will contribute to each course outcome. Developing such a knowledge structure is a challenging job to the teacher to achieve the paradigm shift from teacher centric to learner centric with attaining Outcomes.

2.6 Linkage between OBE components:

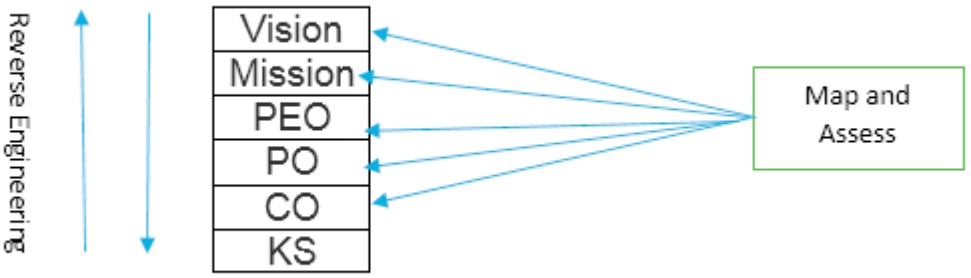

Fig.1. Linkage between OBE components

Vision is the base for developing the programmes for an Institute. Vision can be attained through mission statements. According to vision and mission, programmes and PEOs will be set. To attain PEOs, POs will be developed for each and every programme. The objective of the POs is to develop a graduate in a holistic way by growing them with core knowledge, skill and Behaviour. In General POs are developed using twelve GAs. Each and every course outcome contributes in developing a graduate through POs. For every course outcome will attained by developing knowledge structures. Construction of Knowledge structure for each course outcome is the novelty of the work[8]. Fig 1. shows the linkage between the components OBE. Four or five years after graduation, if the graduates are placed as per vision of the Institute, then it can be ensured that components of OBE served its purpose; else the components can be revised and re-engineered to attain the vision. The following section will detail the construction of KS and its components

3.0 Proposed Knowledge Structure in Power Electronics Engineering

Knowledge structure is a piece of course outcome which can be delivered episodically for a period of 10-15 min. Each knowledge structure may be a kind of basics of Engineering or the facts of science, logics in Engineering or procedural way of doing and the real world problems. Knowledge structure will be developed by infusing GAs with core Engineering. Every Knowledge structure should have the activities that enable the graduates to gain confidence in 'doing'. For example, if the Knowledge structure is aimed to improve communication skill in addition to the core engineering then the graduates should be given the activities like debate on the topic or question and answering within the stipulated KS time. The KS can be constructed only based on the students' behavior and local environment. Hence the four major components of KS are Core Basis(CB),Core Logics(CL), Interdisciplinary Core Logics(IDL) and Real World Problem (RWP)

The role of Real World Problem (RWP) is critical because where from the knowledge structure is to be constructed. The real world problem should be known to the student and it should be the motivating factor. Though the core engineering concept is same, the real world problem will be differed according to the students and the local environment. For example, the RWP, to explain the KS for the students who are studying in IIT, NITs may be totally differed with the students in the rural Institute. Though the contents are same, the RWP that helps to develop the knowledge of the student will be differed. As developing of KS for the same content is differing from Institute to Institute, it is a big challenge for the teacher to develop a student holistically through KS. The KS always starts with RWP with a question 'why' or 'how' instead of 'what', 'where' and 'when'. The following section will develop KS for Phase controlled rectifier in Power Electronics Engineering for students who are studying in geographically

different institutions.

4.0 Design of KS for Phase controlled rectifier

In this section a knowledge structure is designed for the Power Electronics Engineering content such as Phase controlled rectifier. The KS model is designed for the students who are studying IITs/NITs located in urban areas and affiliated institutions located in rural areas. The RWP used to motivate the students who are studying in urban IITs, to learn the content by giving the known example through open ended question such as 'In the AC fed traction system, a DC traction motor is used. How will you vary the DC?'. For the same content, RWP used to motivate the students who are studying in rural affiliated institutions may be with the known example like 'How will you charge 3.3 V, 5 V, 12 V battery using AC charger?'. Though the content is same, RWP to explain the content will differ according to the level of the student to challenge their knowledge. After introducing RWP, the solution to the RWP will be obtained from the students by cueing them towards the content. Then the delivery of the content will be done by interlinking the necessary CBs, CLs, IDLs relating with RWPs. The number of CBs, CLs and IDLs may vary according to the level of the student. Fig.2 and Fig.3 illustrates KS models for students who are studying in IIT/NIT and affiliated institutions.

In this proposed method, only the two levels of student category is considered to develop the KS. But for the same content n number of KS can be developed with variety of RWPs for each and every institutions according to their vision and students. A group of KSs will contribute a course outcome. Similarly, a same RWP can be referred by the multiple episodic KSs which are linked with the same concept. Within each episodic delivery of KS, the activities are encouraged to develop the skills and behavior of students in addition to the core Engineering Knowledge. As so many activities are introduced in each and every episodic delivery, students can gain the confidence towards 'to do'. Hence the teachers have to do a hill of work in developing and assessing the KS, related activities.

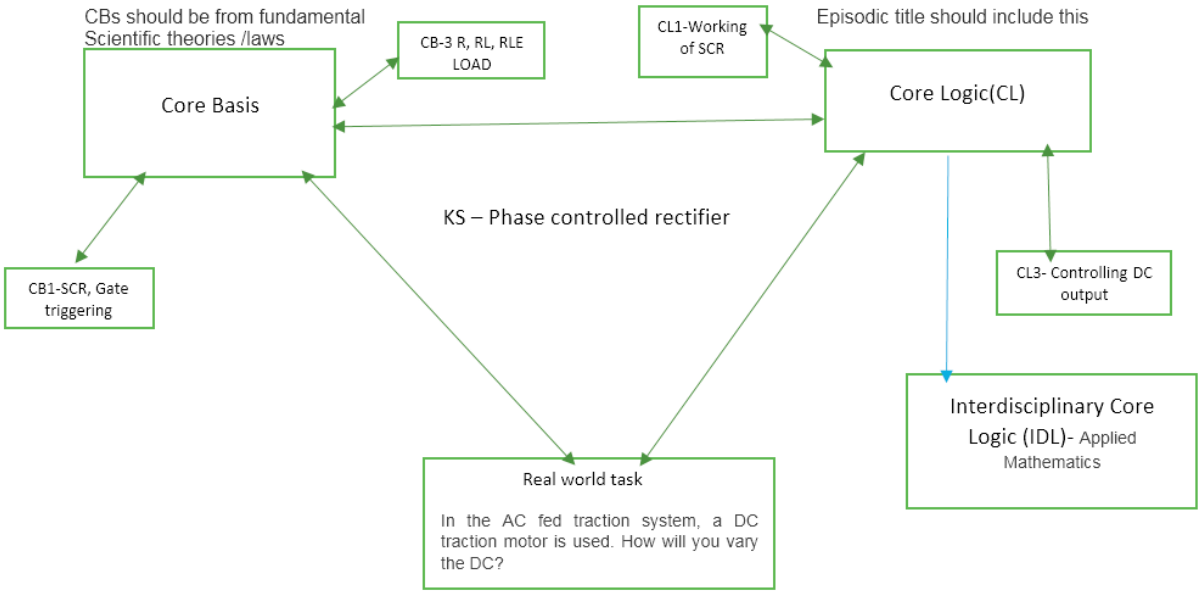

Fig. 2 Knowledge structure Design - model 1

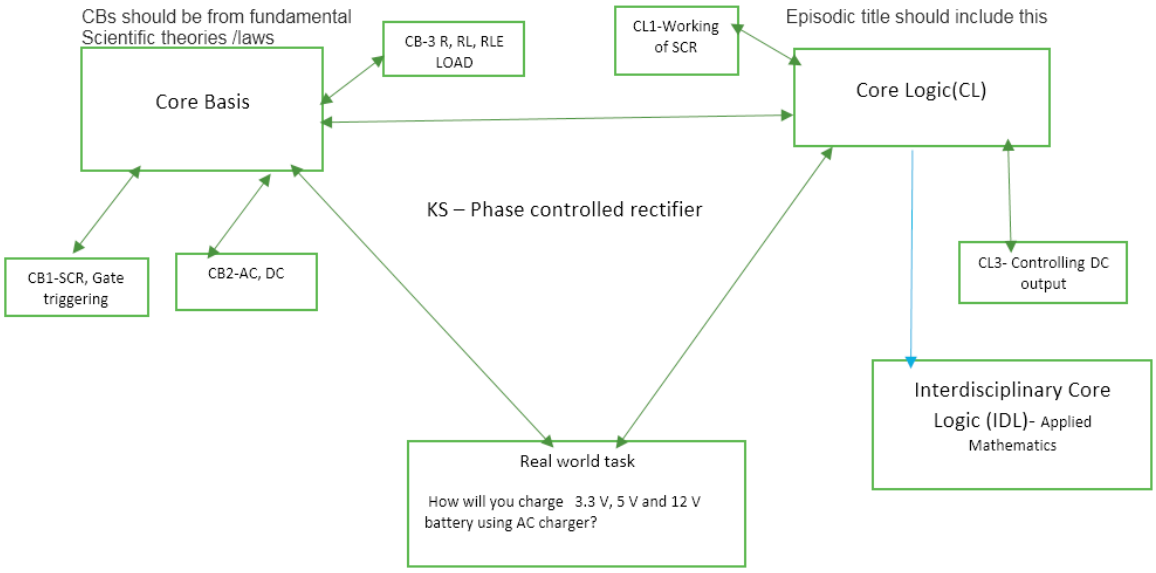

Fig. 3 Knowledge structure Design - model 2

The model 2 was tested with various southern state Technical Teachers from Andrapradesh, Telangana, Karnataka, Tamilnadu, Kerala and Puducherry and the results were ensured by the teachers that the students have gained core Technical knowledge related to Phase controlled rectifier in addition with any of the eight GAs infused in it. Fig 4. Compares the success rate of KS for the various southern states for the sample data of 373 students. From the results it is inferred that the proposed KS based OBE implementation has improved 32.1% over the non OBE model.

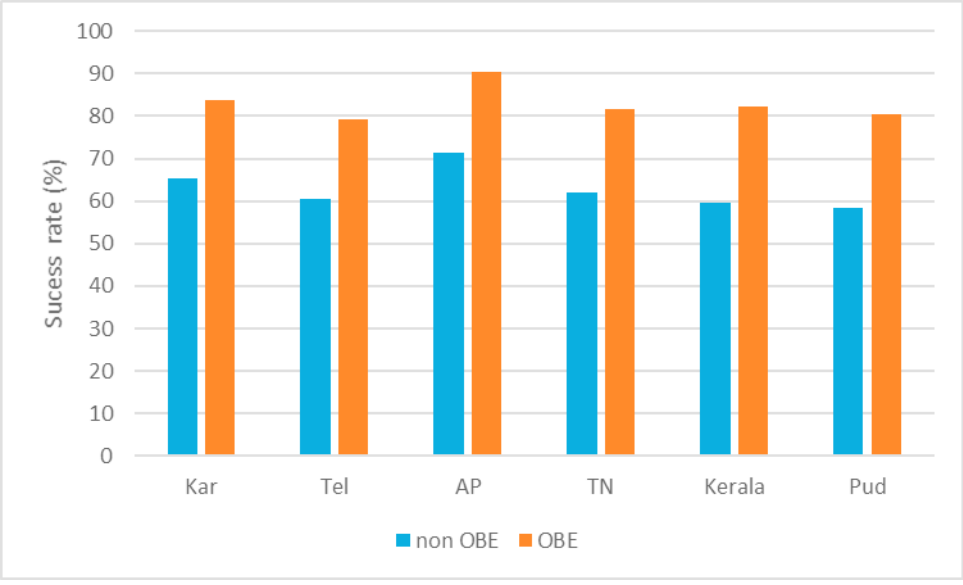

Fig 4. Success rate of OBE

5.0 Conclusion:

In general, Designing of Vision, Mission, PEOs, POs and COs are involved in the process of OBE. But implementing OBE in the Institutions is a challenging job. Implementing OBE will help the students gain confidence in 'doing', in addition to the holistic development of Skill, Behaviour and core knowledge. Infusing the graduate attributes in the course outcome could be done by using the proposed KS. In this work KS was developed for Phase controlled rectifier in Power Electronics Engineering. The developed KS for Phase controlled rectifier utilized the KS components such as CB, CL,IDL and RWP. RWP play a vital role to enhance the holistic development of students.

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