Outcome based education and student learning in survey course of an autonomous institution

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Abstract
Outcome based education (OBE) refers organizing and aligning the educational system towards a set of goals which are essential for all students to be attained at the end of the course/their learning experiences. In this paper, OBE has been implemented for survey course in Civil Engineering Department of an Autonomous Institute. The Department has developed a clear set of learning outcomes for each course around which all of the systems components are focused. OBE establishes the conditions and opportunities within the system that enable and encourage all students to achieve those essential outcomes.

Based on the Programme Outcomes and Programme Educational Objectives, the survey Course Outcomes and Topic Outcomes are formulated. Learning Outcomes are assessed with Programme Articulation Matrix, Course Articulation Matrix and Bloom's Taxonomy level. All the programme assessment methods are listed out and the assessment tasks are evaluated. The average grade attainment level for the survey course is 41.53%. It is observed that most of the programme attributes are met and lead to the conclusion that OBE approach is successfully implemented in the institute.

Keywords: Outcome based education, survey, Bloom's Taxonomy level, Programme Outcomes, Programme Articulation Matrix.

Introduction

Outcome-based education, a performance-based perspective at the vanguard of curriculum development, offers an influential and agreeable way of standardizing and regulating Engineering education. Margery H. Davis[3] defines outcome-based education as an approach to education in which decisions about the curriculum are driven by the exit learning outcomes that the students should display at the end of the course. He also describes the development of outcome-based education. The attention is on the output-what sort of Engineers will be produced-rather than on the educational process. Outcomes are clear learning results that we want students to demonstrate at the end of significant learning experiences.

Spady[2] stated that transitional outcome-based education lies in the twilight zone between traditional subject matter curriculum structures and planning processes. Also, the future-role priorities are inherent in transformational OBE. Current Practice and Critical Issues for Engineering Education have also been discussed.

Malla Reddy Engineering college (MREC) is continuously involved in teaching reform since the institute has upgraded with autonomous status from 2012. MREC(A) is adopting the CIE and SEE approach for assessing student performance in support of an outcome-oriented curriculum. In recent years, the college promotes e-learning and continues the commitment on the outcome-based approach to teaching, learning and assessment as a strategic move to further enhance student learning. The approach is now termed "Outcome-Based Education" (OBE). The Department of Civil Engineering of MREC(A) offers the Surveying Course for the Under graduate students.

In outcome-based education, the Vision, Mission, Program educational objectives, programme outcomes and course outcomes are precisely specified. These regulate the curriculum content and its organization, teaching methods and strategies, courses offered assessment process, educational environment and curriculum timetable. They also provide a framework for curriculum evaluation. In this study, mapping has been done between the PEO and the mission of the department, relation between the Programme outcomes and the course outcomes; assessment of each outcome has been done by blooms taxonomy level and the percentage of grade attainment level with the outcome-based education is also calculated and presented in the form of tables.

Programme Outcomes (PO') and Programme Educational Objectives (PEO'S):

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution.

2. Problem analysis: Identify, formulate and analyze complex engineering problem reaching substantial conclusions using first principles of mathematics, natural science and engineering sciences.

3. Design/ Development of solutions: Design solution for complex engineering problem 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.

4. Conduct investigations of complex problems: Use research-based knowledge and the research methods

including design of experiments, analysis and interpolation of data and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select and apply appropriate techniques resources and modern engineering and IT tools including prediction and modeling to complex engineering activated with an understanding of limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and Teamwork: Function effectively as an individual and a member or leader in diverse teams and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large such as being able to comprehend and write effective reports and design documentation make effective presentations and give and receive clear instructions.

11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member and leader in team to manage projects and in multidisciplinary environment.

12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PEO's:

1. To provide students with a solid foundation in Mathematical, Scientific, software skills and Engineering fundamentals required to solve engineering problems and also to pursue higher studies.

2. To train students with good scientific and engineering breadth so as to comprehend, analyze, design and create novel products and solutions for the real-life problems.

3. To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach and ability to relate engineering issues to broader social context.

Mapping PEO'S with mission of the department: The following table shows the relationship between the program educational objectives and the mission statement of civil department.

Table 1
Relationship between program educational objectives and mission of civil department

Program Educational Objectives	Mission Statement
	Provide value based technical education and empower the students to become
PEO1: To provide students with a solid foundation in Mathematical, Scientific, software skills and Engineering fundamentals required to solve engineering problems and also to pursue higher studies.	X
PEO2: To train students with good scientific and engineering breadth so as to comprehend, analyze, design and create novel products and solutions for the real-life problems.	X
PEO3: To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach and ability to relate engineering issues to broader social context.	X

Mapping PO's with survey course offered by civil department: The table 2 shows the relationship between the Survey course and the programme outcome of civil department.

In particular, table 1 illustrates how the mission phrase map closely relates to the three civil engineering educational objectives. Table 2 illustrates how the programme outcomes are related to survey course offered by civil department. Mapping is reviewed every 2 years cycle for consistency with the need of the member of board of studies. The constituencies of the board of studies are Special Invitee (Principal), Chairman-BOS (HOD), University Nominee (Nominated by VC JNTUH), Two Subject expert member (External nominated by Academic council), Industry expert, Faculty members, Alumini (nominated by Principal).

Table 2
Relationship between programme outcomes and survey course

S.N.	Name of the Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Surveying	3	2	1	3	3	-	-	2	2	3	1	1

* 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High), *If there is no correlation, "-".*

Mapping of programme outcomes involves the systematic assessment and arrangement of individual course with programme goals and objectives. MREC has developed a clear set of programme learning goals. Mapping helps in identifying the gaps and less concentrated areas. For the survey course we map the course to the PO's through programme articulation matrix. In the table 2 the levels are indicated using numbers typically ("- "no correlation, 1- Slight (Low), 2- Moderate (Medium), 3- Substantial (High) indicating the level of attainment. Mapping of each and every subject assist to understand the overall pattern of learning in each programme.

Course outcomes for survey course:
1. Apply basic geometry to detect difference in plane and arc distance over "spherical" earth surface for typical length survey projects.

2. Identify the importance of the compass survey and its practical applications.

3. Apply basic methods and applications of plane table survey.

4. Identify the field applications and concepts of leveling survey.

5. Identify the different methods of calculation of area, contouring and measurement of volumes.

Every course leads to some outcomes. All the courses together must address the PO's and PSO's. The table 3 gives the list of course outcome for survey course along with the mapping against PO's. The table reflects the contribution of individual course outcomes in attainment of PO's.

Teaching and learning processes in the courses can be enhanced by Course articulation matrix. Articulation matrix shows the educational relationship between learning objectives and course's learning outcomes. Here, the outcome of survey course is mapped with programme outcomes using different level of correlation. Mapping factor involved in the correlation level 3 indicates substantially high mapping high concentration towards attainment. 2 indicates moderate mapping medium concentration towards attainment. 1 indicates slightly low. Hence, mapping brings some contribution towards attainment.

Table 3
Relationship between programme outcomes and survey course outcomes

CO	Statement	Program Outcomes											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Apply basic geometry to detect difference in plane and arc distance over "spherical" earth surface for typical length survey projects.	3	3	1	2	3	-	-	2	1	3	-	-
2	Identify the importance of the compass survey and its practical applications.	3	3	1	2	3	-	-	2	1	2	-	-
3	Apply basic methods and applications of plane table survey.	3	3	1	2	3	-	-	2	1	2	-	-
4	Identify the field applications and concepts of leveling survey.	3	3	1	2	3	-	-	2	1	3	-	-
5	Identify the different methods of calculation of area, contouring and measurement of volumes.	3	3	1	3	3	-	-	2	2	3	-	-

* 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High), *If there is no correlation, "-".*

Topic outcome for vth unit (areas and volumes): Bloom's taxonomy is the most widely applied to assess the learning outcomes. The programme educational activities comes under cognitive domain.

1. To compute areas of irregular along irregular boundaries and area consisting of regular boundaries.

2. To determine the area of the land using planimeter.

3. To determine the volume with embankment and cutting for a level section and two-level section.

4. To determine the capacity of the reservoir.

5. To determine volume of barrow pits.

Indication of the Bloom's Taxonomy Levels for the following topic outcomes against every topic outcome
1. To compute areas of irregular along irregular boundaries and area consisting of regular boundaries. (L4)

2. To determine the area of the land using planimeter. (L3)

3. To determine the volume with embankment and cutting for a level section and two-level section. (L5)

4. To determine the capacity of the reservoir. (L5)

5. To determine volume of barrow pits. (L5)

Three topic outcomes attained a level (L5). The indication with Bloom's taxonomy can develop effective outcomes and able to track students' progress through the course.

Table 4
Outcome of the topic and its assessment

S.N.	Topic Outcomes	Bloom's Level	Student activity for each topic outcome.	Assessment of each outcome
1	To compute areas of irregular along irregular boundaries and area consisting of regular boundaries	L4	Practical experiment	1. Categorize the formulae to compute the areas of regular and irregular boundaries. 2.How to Calculate the area using the available data
2	To determine the area of the land using planimeter	L3	Practical Experiment	1. Explain about planimeter. 2. Demonstrate the procedure to determine the area of the land using planimeter. 3. Interpret the results obtained.
3	To Determine the volume with embankment and cutting for a level section and two-level section	L5	Assignment	1. Compare and contrast level section and two-level section 2. Collect the datas of a trench and an embankment in nearby area. 3. Prepare a detail report on volume of the embankment and cutting
4	To determine the capacity of the reservoir	L5	Field survey	1. Organize the data and propose the plan to find the reservoir capacity.
5	To determine volume of barrow pits.	L5	Field survey	1.Organise the data and propose the plan to find the volume of barrow pit

(L1 – Remembering, L2 -Understand L3-apply L4- analyze L5 -Evaluate L6 – Create).

Different modes of course delivery are identified for the survey course and mapped with program outcome are represented in the following table

Table 5
Outcome of the program and delivery

Mode of delivery	Program outcome
Board presentation	1-5, 10, 11
Tutorial	1-5, 9
Practical exercises	1-5, 9
Field visit	6, 7, 8, 9, 11
* Skill development Program	1-5, 9, 10, 11
Projects	1-5, 9, 10, 11
Industrial training	1-11
Seminars	1

*recently implemented in MREC

Illustration of the calculation for the average grade attainment level is shown in table 6 for survey course:

Table 6
Level of average grade

Grade	S	A	B	C	D	E	F
Weightage	0.4	0.25	0.15	0.1	0.05	0.05	0

Actual attainment (%) = (0.4 S + 0.25 A + 0.15 B + 0.1C +0.05D +0.05E)/(0.4 X N)
S = No. of student obtained S grade
A= No. of student obtained A grade
B = No. of student obtained B grade,
C = No. of student obtained C grade
D = No. of student obtained D grade
E = No. of student obtained E grade
N = Total no. of student
Actual attainment (%) = (0.4 X 5 +0.25 X18 +0.15 X 16 +0.1X 3+0.05X7+0.05 X5)/(0.4 X 59) = 41.53%.

Conclusion

The authors implemented OBE in survey course in an autonomous institution. The implementation of Outcome-Based Education (OBE) in MREC gives priority in understanding and knowledge of the OBE. By the achievement of clear programme outcomes with consideration to the appropriateness of each student development level is improved. An effort should be made towards development of outcomes-based learning and in the institution's policy-making decision process. Assessment tasks were evaluated. Desired attributes were met, leading to the conclusion that the OBE approach was a success.

References

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