A Proposed Methodology for Evaluation of the Transportation Engineering Curriculum Using the Outcome-Based-Educational Framework

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Abstract

Each nation's economic and social development depends on a good transportation system that is accessible, efficient, cost effective, reliable, and safe. Therefore, it is essential to offer students the academic requirements to ensure that they can complete their studies with the required knowledge for their professional development. To achieve this, we will revise and redesign the transportation curriculum at our institution through the implementation of the Outcome-Based Educational framework as proposed by Streveler et.al. To accomplish this we propose to establish a methodology that will require us to reference documentation from previous research studies, from the Institute of Transportation Engineers (ITE), and other engineering institutions. We will then compile data from the university that resulted from ABET and other accreditation efforts and institutional documentation to compare and provide recommendations for the curricular re-design.

Keywords

Transportation curriculum, outcome-based education, backward design.

Introduction

The university is facing the need to prepare top academic students by providing them with the right tools and techniques to be successful in their professional careers. Transportation Engineering is a field under Civil Engineering that covers all areas involved in the design, construction and operation of transportation systems. This includes but is not limited to: highways, mass transport, railways, airports, seaports and canals.[1] A nation's economic and social development depends on a good transportation system. In order to be able to offer a continuous expansion that covers all social and economic needs, it's necessary to possess an efficient, cost effective and reliable transportation system. Also, to ensure the accessibility, mobility and effectiveness of the system, it is necessary to have good preservation and rehabilitations plans. New trends in transportation industry requires changes to the infrastructure, operations and planning of the future transportation system. [1]

Therefore, we propose to evaluate the transportation curriculum at our institution and provide suggestions for improvement. This study will allow our institution to meet content requirements but also assess the effectiveness of the teaching pedagogies and evaluation of current assessment techniques. To achieve this, we have decided to use the outcome-based educational framework as proposed by Streveler et.al[3].

Literature Review

Provide engineering students with educational experiences that will last a lifetime is a difficult but necessary task if we want to meet with recent industry challenges and the standards of the engineering accrediting agency (ABET). Therefore, it is essential to find an educational framework that allows universities to offer high quality education, with long-term experience, covering the different ways in which students learn and at the same time producing high-level engineers to the society.[4] To meet these demands it is necessary to incorporate models in the design of courses that are more effective and at the same time allow educators to incorporate innovative learning techniques.[5]

Among these models is the Outcome-Based Educational framework (OBE), which is a student-centered approach that views the curricular design as a design process were the course content assessment and pedagogical techniques must be aligned. This is commonly referred to as a backward design approach.[6] The backward design approach consists of three stages: the first stage consists of identifying the desire results. In this stage goals, content standard, and curricular expectation are established and revised. Stage two consists of determining acceptable evidence such that the collected assessment data validates that the desired content and learning experiences were achieved by students. Finally, in the third stage we need to establish the learning experiences and instructional techniques required to achieve the expected outcomes.

Proposed Methodology

To achieve our goal, we propose to establish a methodology to assess the transportation curriculum. Following the OBE framework, first, we will identify the desired student outcomes. To achieve this we must establish what we want students to know, to be able to do and to be. In his study, Vélez-Rodríguez[2] identified some of the skills required for a Transportation Engineer in his academic preparation. He divided them in three areas: technical, professional and technological. (Refer to Fig. 1).

Technical	Professional	Technologicals
• Computational Science and Engineering • Electric Toll Collection • Rail Transportation • Transit Route Design • Passenger Studies	• Advance English • Technical Writing • Communication • Management of Technology • Interpretation	• Simulation Programs • Database Management • CAD Programs • Transportation Management System

Figure 1: Skills Required by a Transportation Engineer[2]

Then we must select the appropriate assessment techniques that will allow us to determine to what extent students have met the desired goals. For this it is necessary to select and appropriate taxonomy of student learning to establish the curricular objectives. In our case, we will use Blooms Taxonomy[7] since it has been established institutionally. Finally, we must plan the instruction by selecting a pedagogical strategy that is most appropriate.[3] The proposed methodology to be applies is as follows.

Step 1: Identify Desired Outcomes – Establish cognitive requirements and a transportation engineer student profile. We also need to establish curricular goals, content standards (nationwide, state and district) and review curricular expectations. The specific activities proposed includes:

A. Conduct a literature search from previous research studies, official documentation from professional organizations and associations and benchmarking with other academic institutions.

B. Establish learning objectives following Blooms Taxonomy.

C. Collect current data from our academic program according to reports from ABET, departmental procedures and surveys to students, faculty and industry that hires our graduates.

D. Compare findings and report.

Step 2: Assessment - Determine the appropriate method(s) that will allow students to meet the established learning goals. For this we must validate that the desired learning has been achieved and not on which educational units have been covered. The proposed activities are presented as follows:

A. Conduct a literature search on assessment methodologies from previous research studies and benchmark with other academic institutions.

B. Collect information about current assessment techniques being applied according to reports from ABET, departmental procedures and surveys to students and faculty.

C. Evaluate the effectiveness of these techniques.

D. Compare findings and report.

Step 3: Plan Instruction – Determine the appropriate pedagogical method(s) to deliver the desired outcomes and that best fits the selected assessment techniques. The activities proposed includes:

A. Conduct a literature search on pedagogical techniques from previous research studies and benchmark with other academic institutions.

B. Collect information about current pedagogical techniques being applied according to reports from ABET, departmental procedures and surveys to students and faculty.

C. Evaluate the effectiveness of these techniques.

D. Compare findings and report.

Status and Future Work

We are currently in the process of collecting information from external and internal resources for each of the stages. Once the information has been categorized, we will proceed to develop appropriate surveys to gather additional information from students, professors, and industry. Then we will compare, evaluate and report to the Departmental Transportation Committee and Administration and ABET coordinator. It is expected from this study to establish a plan to meet the next ABET accreditation cycle.

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Mr. Heriberto Pujols-Peña is a Graduate Student in Transportation Engineer form the Civil Engineering Department at the University of Puerto Rico at Mayaguez. Also possess a Bachelor in Civil Engineer from the same university. Mr. Heriberto is an active member of the Institute of Transportation Engineer and founder of the first ASEE chapter in Puerto Rico. The ASEE University of Puerto Rico Division, in which he currently serves as vice president. His primary research interest include Transportation Engineering Education, Mass Transportation systems, Traffic engineering and Roundabouts. He is currently evaluating a curricular restructuration of the transportation area in the civil engineering department.

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