Assessment of a Digital Design Course Using the InPods Platform in an Engineering Technology Program

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Abstract: This innovative practice paper details the deployment of the InPods learning management system for course assessment within baccalaureate engineering technology programs. A customized version of this platform is used to implement Outcome-Based Education (OBE), a prerequisite for Washington Accord alignment. We report our firsthand experience using InPods to assess the attainment of Course Outcomes (COs) and correspondingly mapped Program Outcomes (POs) for a Digital Design course. The course was offered to over 1400 students across multiple schools in the Spring 2022-23 semester. The paper briefly discusses course content, laboratory facilities, pedagogy, and the InPods-based assessment process. To our knowledge, this is the first reported use of InPods for CO/PO attainment. We compare the platform's direct attainment results with those from the established Faculty Course Assessment Report (FCAR) tool. This preliminary analysis serves to evaluate the freshman-level Digital Design course and discuss its implications.

Keywords: Assessment; Course Outcomes; InPods; Learning Management System; Outcome-Based Education

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Introduction

The Digital Design course has been frequently assessed in the literature, serving as a key subject for exploring accreditation standards, pedagogical innovations, and curriculum development in engineering education. In alignment with ABET's emphasis on written communication skills, the "writing-to-learn" approach was tested in a writing-intensive sophomore-level Digital Design Laboratory course at the Georgia Institute of Technology [1]. Other works have focused on fulfilling ABET's requirement for hands-on design experience [2], evaluating course impact on student retention [3], and developing methods for direct outcomes assessment [4].

Recent comparative studies of ABET-accredited programs in GCC and non-GCC Muslim-majority countries employ a research methodology similar to this work [5, 6]. Broader comparative analyses of ABET accreditation trends have also been conducted in other global regions, including Africa [7], Europe [8], and Canada and Russia [9].

In this context, this paper shares our firsthand experience implementing a customized version of the InPods platform to facilitate Outcome-Based Education (OBE) at our university. Using a Digital Design course as a case study, we describe the platform's application and provide a brief qualitative comparison between the InPods and Faculty Course Assessment Report (FCAR) tools. Finally, we analyze preliminary results from the InPods platform to review the course offering during the spring semester of the 2022-23 academic year.

Related Work

Scholars have extensively explored curriculum integration and pedagogical tools for Digital Design. To better prepare graduates for industry challenges, the incorporation of asynchronous circuit design into computer engineering curricula has been advocated, with educational modules implemented at the Missouri University of Science & Technology and the University of Arkansas [10]. Other integrations include System-on-Chip (SoC) concepts at Rowan University [11] and programmable logic in an introductory Digital Electronics course in Argentina [12]. These pedagogical developments have also led to the publication of foundational textbooks based on long-standing courses [13].

Innovative teaching methods documented in the literature include a freshman engineering design contest at Loras College [14] and theme-based projects introduced at BVB College of Engineering and Technology to enhance student engagement [15]. Adaptations for modern delivery include converting a Digital Design Fundamentals course to a fully online format at Arizona State University [16]. Studies also examine assessment tools, identifying limitations in outcomes-based platforms like InPods [17] and promoting active learning techniques [18].

A significant portion of related work focuses on the application and refinement of the FCAR methodology for ABET-aligned assessment. Its use was first documented for an associate degree program at Hafr Al-Batin Community College [19] and later expanded to assess courses within the ABET-accredited Electrical and Electronics Engineering Technology (EEET) program at the same institution [19, 20]. Further studies from this college describe the direct assessment of ABET student outcomes, including challenges posed by the Covid-19 pandemic [21], and note that university ranking agencies often overlook ABET accreditation [22, 23].

Further case studies comparing curricula of similarly named international programs have been conducted in accordance with ABET's General Criterion 5 [24, 25], and project-based learning using embedded systems has been implemented with freshman students at Presidency University [26].

Assessment of a Digital Design Course Using the InPods Platform

The Digital Design course (coded ECE2007) was offered during the spring semester of the 2022-23 academic year to over 1400 students majoring in various baccalaureate degree engineering technology programs offered by the School of Computer Science and Engineering and the School of Engineering. One of the authors of this paper was the Instructor in Charge (IC) of the course. Digital Design is a 3-credit hour course with no prerequisites, consisting of two 50-minute lecture sessions and one 100-minute laboratory session per week.

Table 1 presents the Course Outcomes (COs) for the Digital Design course, where CO1 targets the *remembering* level and CO2–CO5 target the *applying* level of Bloom's cognitive domain.

Table 1. Course Outcomes for the Digital Design Course (ECE2007)

CO#	Course Outcome
CO1	Describe the concepts of number systems, Boolean algebra, and logic gates.
CO2	Apply minimization techniques to simplify Boolean expressions.
CO3	Demonstrate the combinational circuits for a given logic.
CO4	Demonstrate the sequential and programmable logic circuits.
CO5	Implement various combinational and sequential logic circuits using gates.

The correlation of each CO to the department's Program Outcomes (POs) is summarized in Table 2, where L, M, and H denote Low, Medium, and High mapping levels, respectively. As can be seen from this table, the Digital Design COs map to 7 POs of the ECE Department at our university. The POs of the ECE Department are formulated by referring to the five ABET Student Outcomes (SOs) as mentioned in the Criterion 3 of the 2023-24 Criteria for Accrediting Engineering and Technology Programs. The PO1, PO2, PO3, PO4, PO5, PO10, and PO12 are related to engineering knowledge, problem analysis, design/development of solutions, conducting investigations of complex problems, modern tool usage, communication, and life-long learning, respectively.

Table 2. Mapping of Course Outcomes to Program Outcomes for the Digital Design Course

CO#	PO1	PO2	PO3	PO4	PO5	PO10	PO12
CO1	H	M	L	L	L	L	L
CO2	M	H	H	L	M	L	L
CO3	H	M	H	M	M	L	L
CO4	M	M	H	M	H	M	L
CO5	M	H	L	H	H	M	L

The 1400+ students were grouped into 25 sections, each with roughly 60 students. Twelve faculty members handled the lecture sessions. Each laboratory session was supported by a co-faculty member and a laboratory technician. Experiments were conducted using online simulators (CircuitVerse or Multisim Live) and covered topics from basic logic gates to HDL coding for combinational and sequential circuits. The laboratory component was assessed through report submissions (and optional viva voce) and accounted for 40 marks.

The lecture content was divided into three modules: Boolean function simplification, combinational logic circuits, and sequential/programmable logic circuits. Faculty reported that the current schedule (two lectures per week) was insufficient to cover the syllabus, prompting a proposal to increase the course to 4 credit hours. In the interim, some theoretical content was delivered during laboratory sessions.

Due to varying paces across 25 sections, some advanced topics (e.g., HDL models, Mealy & Moore machines) were designated as self-learning or participative learning activities. Tracking syllabus coverage was crucial as midterm and end-term examinations were common for all sections.

For this pilot study, data from two sample sections (≈120 students total) were analyzed using InPods. As shown in Figure 1 and Figure 2, none of the five course outcomes were attained at the set targets (60% of students scoring ≥60% of the marks). Consequently, PO attainment was not analyzed. The overall passing criteria for the course required a minimum of 80/200 total marks and 45/150 in combined examinations.

The data capture process for InPods analysis was labor-intensive. Evaluators manually recorded question-wise marks from exam scripts into specific Excel templates. This task is prone to error, especially at scale.

The platform requires four separate Excel files per section (homework/quiz, lab reports, midterm, end-term), adhering to a strict syntax—a significant usability hurdle. We recommend that the InPods team simplify this process by allowing a single consolidated file upload.

Given the workload, we suggest sampling for large courses. Collecting data from 3-5 high, average, and low performers per section (9-15 samples total per section) would provide a robust dataset (225-375 samples for 25 sections) while saving faculty time and improving data accuracy. This sampled approach would yield reliable results for continuous course improvement.

A similar course, Digital Electronics (ECE2002), is offered for ECE students with identical content but uses physical digital trainer kits instead of software simulators.

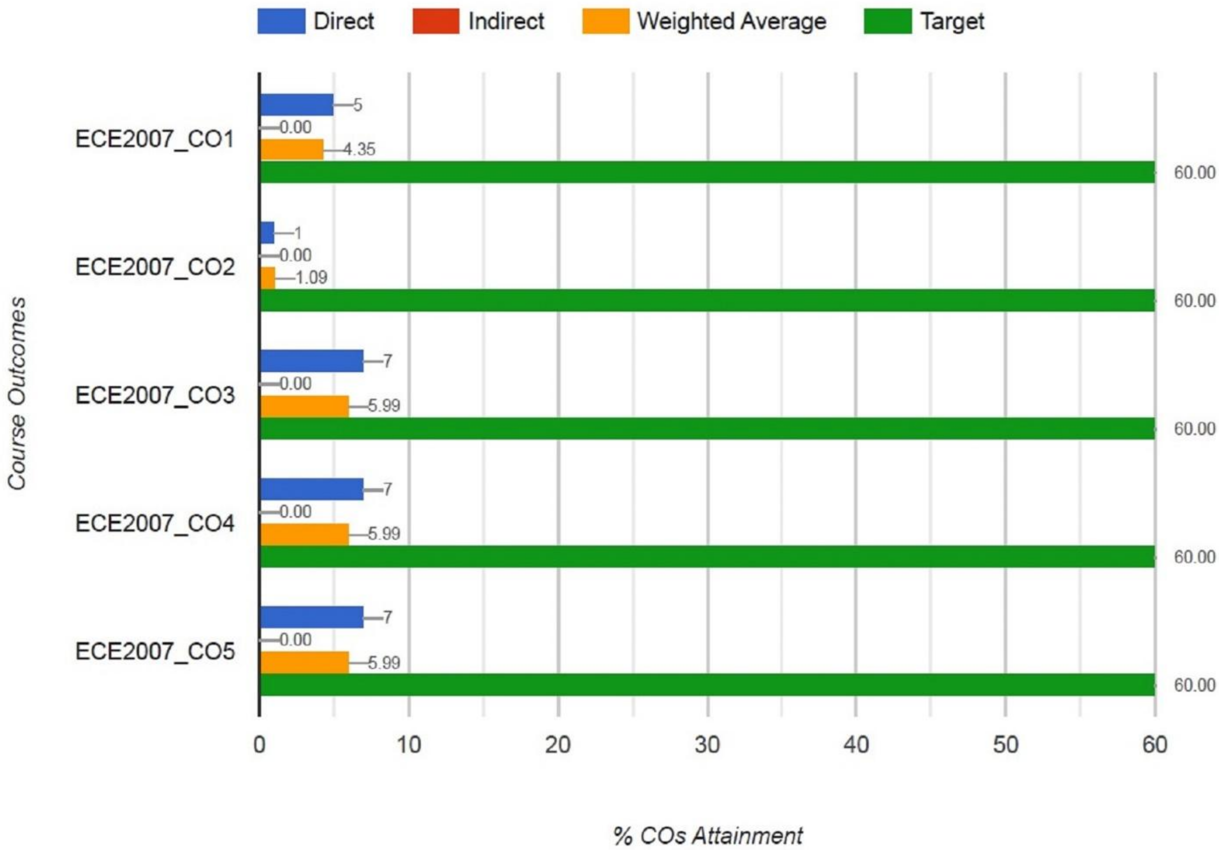

Figure 1. Attainment of Course Outcomes for Digital Design (ECE2007) - Section 1

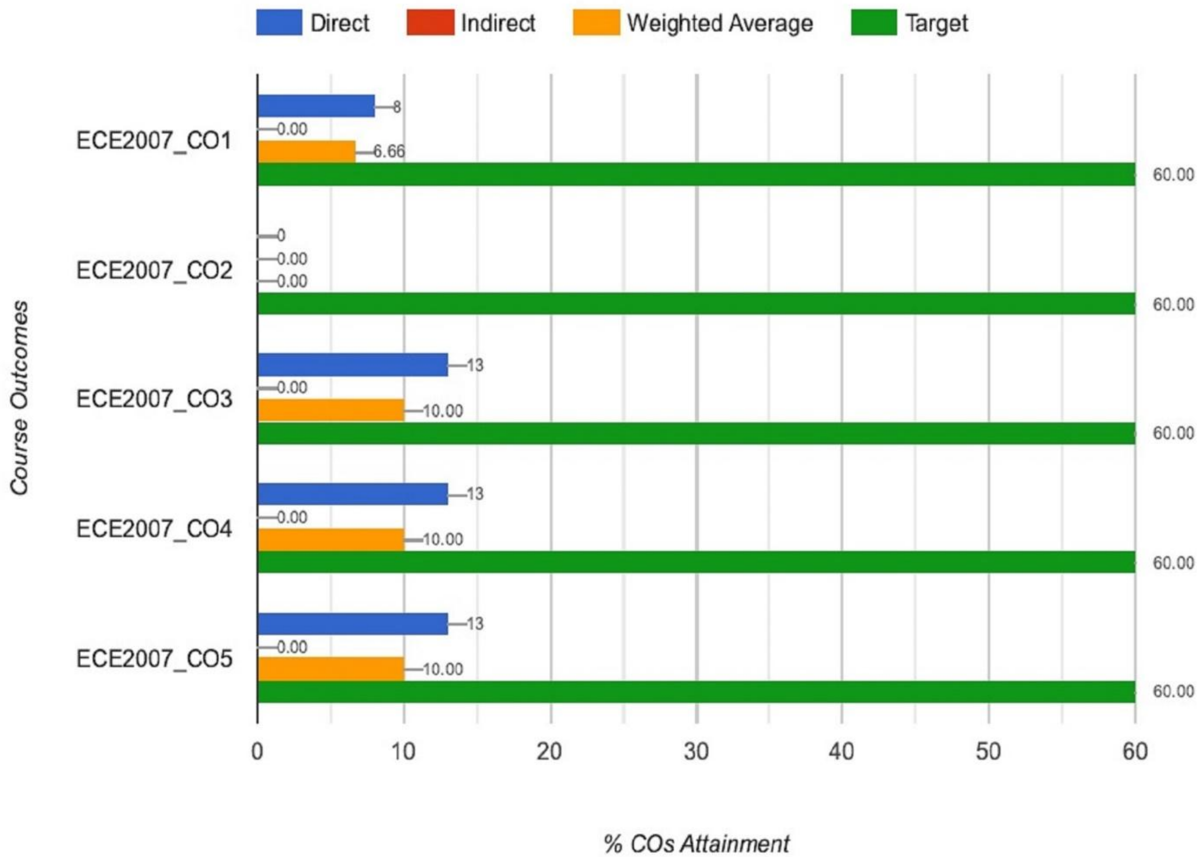

Figure 2. Attainment of Course Outcomes for Digital Design (ECE2007) - Section 2

Comparison of InPods and FCAR Tools

The FCAR tool is more suitable for analyzing courses with smaller enrollments and can be implemented using Excel. It allows for easy customization. In contrast, the InPods platform is designed for large-scale student data and features a dedicated software suite to monitor CO-PO attainment throughout a student's degree cycle. While InPods offers limited front-end customization (e.g., thresholds and targets), greater customization requires backend intervention by administrators. Beyond assessment, InPods is also extensively used at our university for moderating and generating examination question papers.

Conclusions

This pilot study used the InPods platform to analyze a sample from the Spring 2022-23 Digital Design course. The primary finding is that none of the five course outcomes were attained at the expected target level. This result, coupled with the significant logistical challenge of manual data entry for large cohorts, raises critical questions for curriculum design and student engagement: Is the Digital Design course introduced too early? Should it be offered at the sophomore rather than the freshman level? Is a prerequisite course needed? Furthermore, how can students in modern B.Tech. programs (e.g., Artificial Intelligence, Data Science, Cybersecurity) be motivated to engage seriously with a core ECE department course they may perceive as outside their major?

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