

Alignment of first year engineering course learning outcomes as perceived by faculty at a four-year institution and its transfer community college

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Work in Progress: Alignment of FYE Courses Across Transfer Institutions

Abstract

This work in progress compares perspectives of engineering faculty at a state community college system (SCCS) and faculty at a public postsecondary institution in the college of engineering (COE) around first-year engineering (FYE) course delivery and equivalency across transfer programs. Community colleges that can develop transferable FYE courses allow students to meet prerequisites and follow a path similar to non-transfer students, thereby addressing some time-to-degree concerns associated with the transfer pathway. Although these courses are theoretically equivalent according to the articulation agreement, the setting, student population, and resources are not always similar across programs, and therefore students' experiences may vary. We conducted a series of semi-structured interviews with SCCS and COE faculty and completed a thematic analysis that highlights learning outcome priorities, teaching strategies, and relationships between different institutions. Although faculty attend to the same general course objectives, delivery methods vary and are catered to students at each institution, resulting in very different course experiences.

Introduction

Community college can be a cost-effective higher education option for students that can serve as a gateway for upward mobility. The process of transferring from a community college to a 4-year college can be overwhelming, however, students must navigate numerous and sometimes conflicting policies. Although articulation agreements between 2-year and 4-year institutions vary across contexts, many focus on preserving credits for students who transfer [1]. Despite these agreements, research indicates that vertical engineering transfer students take longer to complete a bachelor's degree than non-transfer students [2]. One of the reasons for this lag in time to degree is the sequential nature of required coursework towards engineering degrees and missing prerequisites at the time of transfer. Community colleges that offer transferable first-year engineering (FYE) courses allow students to meet prerequisites prior to transfer. In theory, this enables progress towards their degree on pace with their non-transfer student peers.

Although FYE courses are theoretically equivalent according to the articulation agreement, the setting, student population, and resources are not always similar across programs, and therefore students' experiences may vary. Although there is prior research on developing and evaluating courses and curricula within one institution, the same attention has not been paid to consider how course development compares across institutions [3]. The purpose of this work in progress is to explore faculty perceptions of FYE student outcomes and experiences in articulated courses. The guiding research question is: How do FYE faculty perceive equivalent foundational engineering courses at a community college compared to a university?

Methods

This paper provides a single case study exploration of the development and implementation of FYE courses at a community college and a receiving institution. The bounds of this study are confined to a single community college (CC) that operates in the state community college

system (SCCS) and one college of engineering (COE) receiving institution. These two institutions have an articulation agreement that guarantees admission to the COE with an earned associate degree and a minimum GPA. The FYE courses are part of the articulated courses in the state system and complete degree requirements at the receiving institution. We conducted semi-structured interviews with eight engineering faculty, four from CC and four from COE. The interviews explore the perceptions of faculty on FYE courses and the alignment with personal views and receiving institutions. Interview questions were developed and reviewed by a team with professional experience in the articulation and transfer process and course development.

Results and Discussion

For both institutions, FYE course content summaries are broad, leading to variation and interpretation of the best ways to meet the stated objectives. One CC faculty member describes the course to students in the following manner:

I always tell them this is kind of a survey course. Each of these chapters that we look at, each of these modules and units could be a course unto themselves.

CC and COE faculty agreed that one of the purposes of the FYE courses is to prepare students for a career in engineering. The means of achieving this objective varied between faculty groups. CC faculty pointed to specific engineering fundamental content knowledge to fulfill this course outcome as one faculty member articulates:

Fundamental [concept] is force, free body diagrams, unit conversion, electric circuit, dynamics.... This is very important for them to have this kind of concept to be able to deal with the next classes

In contrast, COE faculty pointed to career exploration and the design process to help students develop an engineering identity. COE faculty scaffold activities, such as personal reflections, research papers, and team projects, for students to explore engineering disciplines.

All CC participants also teach second-year engineering courses. They use topics and problems from the second-year courses to relate students' current math and science courses with their future engineering courses. CC faculty try to develop engineering identity by building students' confidence in their technical ability and making connections with prior knowledge.

Unlike the CC faculty, none of the COE participants teach second-year engineering courses, and many do not connect with degree-granting engineering departments. Instead, they try to guide students during their first year of college to develop and mature while learning how to think like engineers. One COE faculty describes the methods this way:

I think that the things that we do in the course are very valid. They are more valuable than the stuff the students are getting in chemistry and physics and calculus frankly, because the things that we're talking about are, you know, how do you figure out what you need to know.

CC and COE faculty mention characteristics of their students and how each course approach is tailored to students at their respective institutions. COE faculty describe FYE students as living away from home for the first time and needing support in their college transitions. In contrast,

CC faculty describe their students as juggling rent, work, and family responsibilities, and the majority of these students are not in their first semester of college. Course equivalencies allow for flexibility to provide students with what they specifically need for a career in engineering.

Our findings show that the primary goal of the course as stated by all participants is to prepare students for a career in engineering. For the COE faculty, that means using FYE courses to aid in students' growth and maturity. For the CC faculty, this means focusing on the technical aspects to help prepare students for future coursework. These results have implications for conversations about course equivalencies, articulation agreements, transfer partnerships, and the extent to which experiences may vary across settings.

Future Work

This work in progress intended to isolate faculty perceptions of course development by removing institution variation. Potential future efforts involve repeating this work with CC and COE faculty from other state institutions. In addition to expanding this work to more faculty, comparing the assessments between institution types would help determine if the difference in course delivery is salient.

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References

- [1] J. Roksa and B. Keith, "Credits, Time, and Attainment: Articulation Policies and Success After Transfer," *Educ. Eval. Policy Anal.*, vol. 30, no. 3, pp. 236–254, Sep. 2008, doi: 10.3102/0162373708321383.
- [2] D. Grote, D. B. Knight, W. C. Lee, and B. A. Watford, "Navigating the Curricular Maze: Examining the Complexities of Articulated Pathways for Transfer Students in Engineering," *Community Coll. J. Res. Pract.*, pp. 1–30, Aug. 2020, doi: 10.1080/10668926.2020.1798303.
- [3] J. Wyner, K. Deane, D. Jenkins, and J. Fink, "The Transfer Playbook: Essential Practices for Two- and Four-Year Colleges," p. 60, 2019.