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Hybrid Engineering Matriculation Model to Promote Informed Engineering-Major Selection Decisions

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1. Introduction

Students who chose an engineering major because they identify with the engineering-related activities of that field are more likely to be retained. The limited knowledge of engineering that most students posses when they choose an engineering major negatively effects their commitment to their selected major [1]. Introduction to engineering courses are one way to promote informed engineering major decisions among engineering students [2,3].

However, one of the most prominent models for first-year engineering (FYE) is the direct matriculation model [4], in which students must select a major before enrolling in a single university-level course. While some high schools do have engineering courses, many, especially those in poor rural areas, do not. In areas without engineering courses, students often rely on non-engineering professionals (e.g., high school counselors) to make engineering-major decisions. Despite efforts to "change the conversation", it is still commonplace for these non-engineering professionals to state that a student should major in engineering simply because the student excels in math and science. Thus, the direct matriculation model often involves uninformed decision making when students are choosing a major. For retention purposes, it is important for colleges of engineering to support informed decisions regarding engineering-major choice.

In this paper we discuss our efforts to promote informed decision making within the context of a direct matriculation model. We are exploring a hybrid model for FYE. Our hybrid model preserves our existing eight major-specific introduction to engineering course within our eight engineering departments and supplements them with a general introduction to engineering course for undecided students. Within our current model, students are readily able to transfer between engineering degree programs. The hybrid model does not lessen the ability transfer, but rather provides an additional time period for information gathering and informed decision-making during the first year. Our hybrid model is targeted at students who meet all the standard admission requirements for engineering, but do not know which degree program they want to pursue. In the remainder of this paper, we describe two primary challenges for transitioning to the hybrid model (Sections 3 and 4), the resultant introduction to engineering course that was developed and piloted in Fall 2014 (Section 5 and 6), our future trajectory for our hybrid model (Section 7).

2. Institutional Context

Mississippi State University is a rural, research-focused, public, land-grant institution with an enrollment of 16,500 undergraduate students and 3,700 graduate students. The college of engineering (CoE) is the third largest college with an enrollment nearing 2,900 undergraduate and 700 graduate students. The student population is 80% male. The CoE has eight departments: Aerospace Engineering (ASE), Agricultural and Biological Engineering (ABE), Chemical Engineering (CHE), Civil and Environmental Engineering (CEE), Computer Science and Engineering (CSE), Electrical and Computer Engineering (ECE), Industrial and Systems Engineering (ISE), and Mechanical Engineering (ME). The CoE's eight departments offer a total of ten, four-year engineering undergraduate degree programs: aerospace engineering (AE), biological engineering (BE), chemical engineering (CHE), civil engineering (CE), computer engineering (CPE), computer science (CS), electrical engineering (EE), industrial engineering (IE), mechanical engineering (ME), and software engineering (SE). [Note that the degree program acronyms do not always match the department acronyms.] The CoE's direct matriculation model [4] utilizes a discipline-specific approach to FYE in which each of the eight engineering departments is responsible for required course development and instruction. There is wide variation between departments' courses. Across the college, approximately 850 students were enrolled in first-year courses in Fall 2013.

Over the past few years, Mississippi State University has seen a steady increase in the number of undecided engineering students (see Figure 1). These students meet the minimum admission requirements for the college (a composite ACT score greater than or equal to 23, or a high school GPA of 3.5 of above) but have not decided on a specific major. Figure 1 compares the average ACT score for undecided students with the average university ACT score. The college has not previously had a formal mechanism in place to meet the academic needs of these students because academic advising and introduction to engineering courses are department-specific. During orientation when it is time for academic advising, undecided students are asked to select a major in order to be advised and plan a schedule. To overcome this deficiency, we are actively exploring a transition to a hybrid matriculation model.

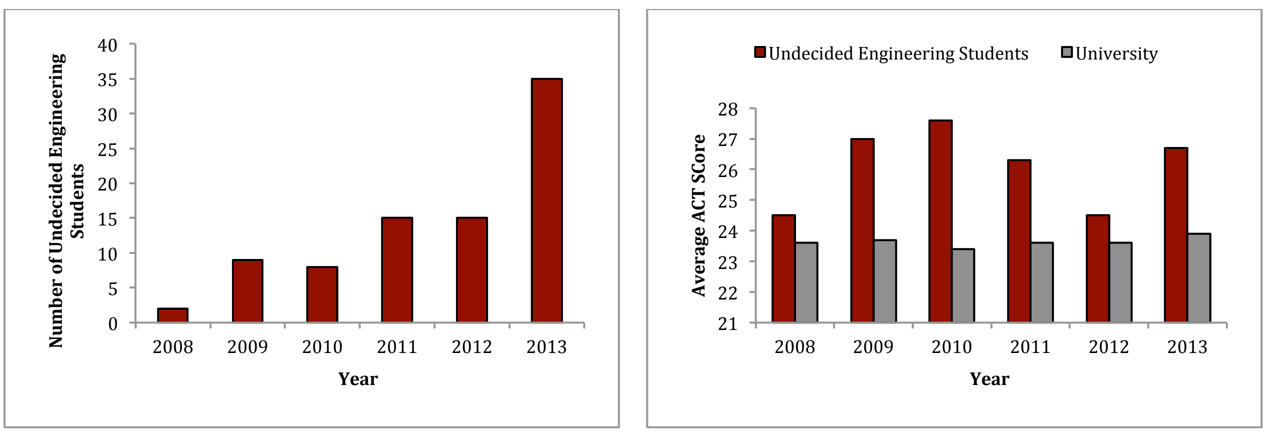

Figure 1. Number of undecided engineering freshman students and average ACT score for the past six years

3. Barrier to Change: Eight Different Introduction to Engineering Courses

In preparation to transition to a hybrid FYE model, in Fall 2013 we conducted an assessment of existing major-specific intro courses at our institution. We utilized Reid and his coauthors' FYE classification scheme [5] to examine differences and similarities for course content in the existing courses. An engineering education expert conducted a semi-structured interview with faculty in each department who were assigned instructional responsibilities for the department's introduction to engineering course. Interview questions were designed to illicit details regarding primary course topics, class enrollment, and instructional design. At the end of the interview, each department representative indicated primary course topics using the checklist created by Reid et al. and provided the research team with a course syllabus. The results of our assessment are summarized in Table 1, with content classification codes referencing the Reid et al. classification scheme (i.e., DESN – Design; ESTT – Engineering Specific Technical Tools; ENPR – Engineering Profession; ACAD – Academic Advising). Although most courses included content in multiple categories, following recommendations by Reid and his coauthors, we identified the top one or two content classifications for each course based on the percentage of subtopics covered in the course and the percentage of course time dedicated to each topic.

Table 1. Summary Of Eight Department Introduction to Engineering Courses

Department	FYE Course(s)	Credit Hours	Contact Hours	Typical Course Enrollment	Primary Content Classification
Aerospace Engineering (ASE)	Intro to Aerospace (Fall only)	3	6	70	DESN/ESTT
	Astronautics, Propulsion, and Structures (Spring only)	3	6		DESN/ESTT
Agriculture and Biological Engineering (ABE)	Engineering in Life Sciences (Fall only)	1	1	140	ENPR/ACAD
	Intro to Engineering Design (Spring only)	1	2		DESN
Chemical Engineering (CHE)	CHE Freshmen Seminar (Fall only)	1	3	100	DESN/ESTT
	Chemical Engineering Analysis (Spring only)	3	3	90	DESN/ESTT
Civil and Environmental Engineering (CEE)	Intro to CEE (Fall only)	1	3	110	ENPR/ACAD
Computer Science and Engineering (CSE)	Intro to CSE (Fall only)	2	2	70	ENPR/ACAD
Electrical and Computer Engineering (ECE)	Intro to ECE	2	4	150	ENPR/ESTT
Industrial and Systems Engineering (ISE)	Intro to IE (Fall only)	1	3	70	ENPR/DESN
Mechanical Engineering (ME)	Intro to ME (Fall only)	1	1	150	ENPR/DESN

Our FYE course assessment highlighted substantial differences in content, credit hours, and instructional design across all eight major-specific FYE courses. Five departments (ASE, ABE, CHE, ISE, and ME) identified engineering design as a content focus area for their course(s). Six departments (ABE, CEE, CSE, ECE, ISE, and ME) identified engineering profession as a focus area, primarily through the inclusion of introduction to the major and introduction to the profession topics. Engineering specific technical skills and tools were significant for three departments (ASE, CHE, and ECE). Three departments (ASE, ABE, and CHE) offer a two-course introduction to engineering sequence with the remaining five offering a single introduction to engineering course. ECE is the only department that offers their introduction to engineering course both semesters. Though there is a push within the college to move towards project-based learning design projects for first-year courses, only the ASE, CHE, and ME departments currently use project-based learning in their first-year courses. Our initial assessment of FYE courses within the college demonstrated the wide variability of each course.

A significant challenge we faced while developing this course related to addressing differences between existing major-specific courses. In the current direct matriculation model, some departments will accept other departments' introduction courses, while others will not. Ultimately, we determined that developing a general introduction to engineering course that would satisfy all requirements for all departments was not feasible without significant curricula changes. Instead we focused on developing a course that would satisfy requirements for a majority of departments and clearly informed students of the departments that would require their own major-specific intro course in addition to the general course.

We developed an introduction to engineering course to support informed decision making for students' engineering major selection. Based on our assessment of existing courses, we designed the course with an engineering profession and engineering design focus (Table 2). The course was approved as a substitute for existing departmental introduction to engineering courses in six of ten degree programs. Students ultimately choosing to pursue AE, CPE, EE, or IE degrees would need to complete the department-specific introduction course at the next offering. For AE only, that requirement results in a one-year graduation delay. Thus, if students showed any interest in AE were advised to enroll in both introduction courses in Fall 2014. No students pursued the dual-enrollment option.

Table 2. Overview of new Introduction To Engineering Course for the Hybrid Model

Department	FYE Course(s)	Credit Hours	Contact hours	Fall 2014 Enrollment	Primary Content Classification
Fall 2014 Pilot Course	Intro to Engineering (Fall only)	1	2	21	ENPR/DESN

4. Barrier to Change: Ten Different Engineering Degree Programs

A second significant challenge we faced while transitioning to the hybrid model was related to advising students who could enter any of ten different engineering programs. For entering freshmen that meet the standard engineering entrance requirements and have no prior college credit, including AP credit, advising was straightforward. Undecided students in that situation were advised to enroll in English composition I (3 credit hours), calculus I (3), chemistry I plus lab (4), introduction to engineering (1), and a humanities elective (3) for a total of 14 credit hours (12 hours is full-time status). However, for students with significant prior college credit, including community college transfer students, or students who were not calculus-ready, advising was more challenging.

To assist with advising, we completed an assessment of the ten engineering degree programs for the purpose of identifying common courses for each program. Our assessment results are summarized in Table 3. The results allowed faculty advising undecided engineering students to recommend courses that were applicable to multiple engineering degree programs so that courses would count towards a student's degree when they chose an engineering degree program.

However, especially in the case of community-college transfer students, there were multiple times when students had already earned credit for the common courses and needed to enroll in engineering courses that were program-specific. Students who had earned significant college credit were advised to select an engineering major and were not allowed to participate in the Fall 2014 hybrid pilot. We are continuing to investigate ways to accommodate these students in within our hybrid matriculation model.

Table 3. Common Courses for Ten Engineering Degree Programs

<table>
<tr><th>Course</th><th>AE</th><th>BE</th><th>CHE</th><th>CE</th><th>CPE</th><th>CS</th><th>EE</th><th>IE</th><th>ME</th><th>SE</th></tr>
<tr><td>English Comp I</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>English Comp II</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Chemistry I</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Chemistry I Lab</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Chemistry II</td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>Chemistry II Lab</td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Physics I</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Physics II</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Calculus I</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Calculus II</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Calculus III</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Calculus IV</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Differential Equations</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td rowspan="2">1 of these</td></tr>
<tr><td>Linear Algebra</td><td>X</td><td></td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Statistics</td><td></td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td></tr>
<tr><td>Public Speaking</td><td></td><td></td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td></tr>
<tr><td>Intro to Programming</td><td></td><td></td><td></td><td></td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td>X</td></tr>
<tr><td>Intermediate Programming</td><td></td><td></td><td></td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td>X</td></tr>
<tr><td>Engineering Graphics</td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Electrical Circuits I</td><td>X</td><td></td><td rowspan="2">1 of these</td><td></td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Mechanics I</td><td>X</td><td>X</td><td>X</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Mechanics II</td><td>X</td><td>X</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>Humanities Elective</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Social Science Elective</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Fine Arts Elective</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>

5. Hybrid Introduction to Engineering Course Design

In Fall 2014, our general introduction to engineering course was piloted. Based on our assessment of current introduction to engineering courses at our institution (Section 3), the overarching goal of the course was to introduce students to the different engineering disciplines and principles associated with engineering design. Consequently, by the end of the course, it was our expectation that students would be able to:

1. Articulate the fundamental differences between the engineering disciplines
2. Work in a team environment to solve engineering problems
3. Write technical communications for various audiences

We used a combination of laboratory worksheets, laboratory reports, quizzes, concept maps, and a final paper assignment to evaluate student learning.

The course was taught by six faculty and was comprised of five modules (engineering topics and panel sessions) that introduced students to the various engineering degree programs. The five course modules were:

- Engineering Mechanics (Mechanics)
- Process Engineering (Process)
- Product Dissection (Dissect)
- Technical Writing (Writing)
- Engineering Discipline Panel Sessions (Panels)

The technical writing module was intermingled with the engineering modules (Figure 2) so that technical writing activities could align with engineering design activities. The panel sessions were also intermingled because the course designers believed back-to-back panel sessions could be monotonous or result in information overload.

Module	**Week**														
	2	3	3	4	5	6	7	8	9	10	11	12	13	14	15
Mechanics	■	■		■											
Process						■		■	■						
Dissect											■	■		■	
Writing			■				■						■		
Panels					■					■					■

Figure 2: Schedule of Activities during the Fall 2014 semester.

Engineering Mechanics Module: As shown in Figure 2, this was the first module presented to the students. The mechanics module was led by an aerospace engineering faculty member and included introductions to aerospace engineering aerodynamics and engineering mechanics with a focus on aerospace structures. The units incorporated experimental, analytical and computational elements. Week 1 consisted of an introduction to aerospace engineering and emphasis was placed on the discussion of air vehicles, covering both aeronautical and astronautical applications. Each student team, consisting of three members each, was required to select an air vehicle and make a 5-minute PowerPoint presentation regarding their selection. In

Week 2, an introduction to aerodynamics and fundamentals of flight was presented. Group activity for this segment included fabrication and testing to determine the drag coefficient of simple aerodynamic structures. Student teams fabricated parachutes using readily available materials (e.g., paper, textiles, balsa wood, plastic containers) with the goal of producing a stable vehicle. The parachutes were tested in a wind tunnel and the acquired data was used to determine the drag coefficient for each parachute. This activity required a hands-on component to fabricate and test the parachutes, become familiar with using real test data to perform computations, and finally to submit a final report. An introduction to aircraft structures was presented in Week 3. This included a hands-on group activity in which the strength and deflection of a simple wing spar/beam was determined using a Beam Test System previously developed by Sullivan and Rais-Rohani [6]. Throughout the three-week module, students were exposed to fundamental engineering mechanics principles with a focus on aerospace structures, materials and experimental methods. .

Process Engineering Module: The process module was led by a chemical engineering faculty member and was structured to include a series of "Team Challenges" (i.e. design projects and active experimentation). Through the Team Challenges students engaged in activities focused on fundamental process engineering and teaming concepts to help them better visualize and understand engineering practice. Figure 3 illustrates the broad range of topics covered in Learning Outcomes for each team challenge. Student teams were given the opportunity to choose a specific Team Challenge based on team members' interest. Within the three-week module the teams performed a series of activities to 1) investigate their chosen problem, 2) design, build and test a solution, and 3) refine the solution to improve the final solution. Team challenge topics included:

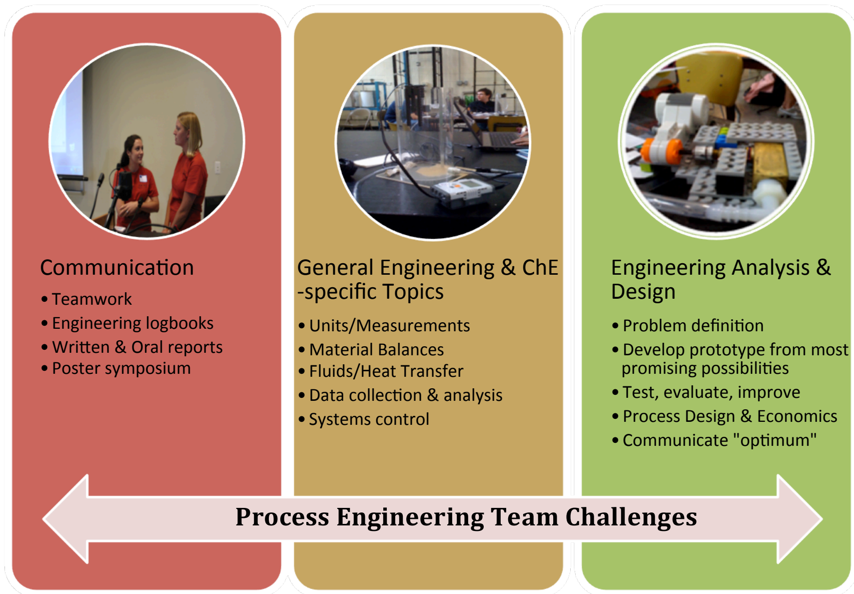

Figure 3. Overview of topics taught by each team challenge.

1. Learning about heat transfer in a double-pipe heat exchanger
2. Design, optimization, and economics of a simple solar oven
3. Process control for maintaining tank level
4. Estimation of thermal conductivity for a series of unknown metals

Team Challenge topics were previously designed for and used in a chemical engineering freshman course [7].

Product Dissection Module: Two electrical and computer engineering faculty members led the product dissection module. The module was based on recommendations outlined for product dissection in mechanical engineering [8,9] and followed a four-phase model (Figure 4). Week 1 learning activities were focused on familiarizing students with basic electrical components and devices (e.g., resistors, breadboards, multimeters) and fundamental electrical concepts (e.g., current, voltage, Ohm's Law) to provide the necessary background for product dissection. During Weeks 2 and 3, students dissected LEGO NXT sensors that they used in the process engineering module. Students also built prototype sensors from basic electrical components (e.g., light sensor – photoresistor, temperature sensor – thermistor). Students then compare their prototype to the circuitry of the corresponding dissected LEGO NXT sensor. Students collected, plotted, and compared measurements from their prototype sensors and functional LEGO NXT sensors. At the end of the module, students created a final video to demonstrate that they could 1) explain the basic functionality of multiple sensors from the perspective of the underlying circuit elements, and 2) explain differences between prototype sensors built on breadboards and production-level, professionally packaged sensors.

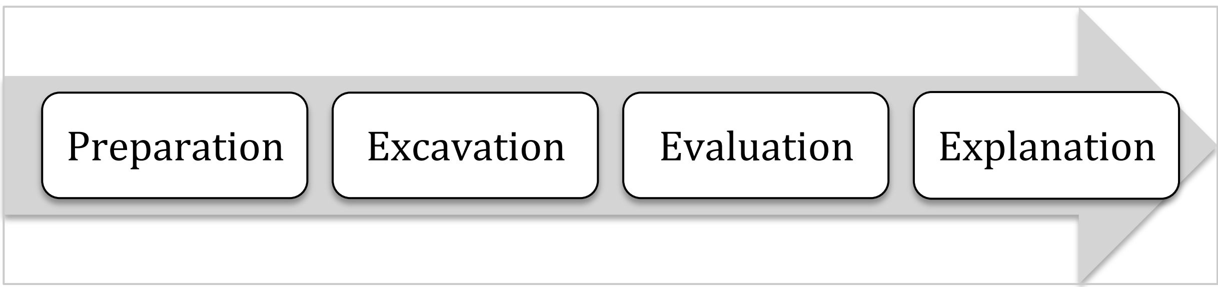

Figure 4: Four-phases for product dissection based on product archaeology [8,9]

Technical Writing Module: The technical writing module was taught by one of the college of engineering technical writing instructors. The focus of the module was to introduce students to the principles of effective technical communication, particularly the importance of focusing on purpose and audience, and to introduce students to methods of finding and documenting sources. In Week 1, students examined popular science fiction treatments of real engineering topics, considering whether the portrayals revealed the public's misunderstanding of these topics. In Week 2, the major paper assignment was introduced, including the collaborative challenges of preparing a group paper. Students were introduced to the methods of conducting academic research using credible Internet sources and the library's research databases. Strategies for writing accurate, vivid technical descriptions were presented using a collaborative in-class activity in which each group examined the validity of a news story (i.e., Is it real or science fiction?). The article examination required groups to research the story and describe the science behind it. In Week 3, the writing module focused on avoiding academic dishonesty and included time for peer-review of students' major paper assignment via draft swapping.

Engineering Discipline Panel Sessions: The Associate Dean for Academic Affairs coordinated the panel sessions. While the engineering modules were general in nature and did not discuss a particular engineering field per se, they were framed in the context of the engineering discipline of the faculty member leading the module. The panel sessions were designed to provide students with an overview of engineering disciplines not represented by course instructors. Thus, ABE, CEE, CSE, ISE, and ME hosted panel sessions with two 45-minute panels held on each panel day. Suggested panel composition included a student, a faculty member, the undergraduate coordinator, and the department head, with final panel composition left to department heads' discretion. Each panel was asked to briefly introduce different concentrations available in their major, typical career paths of their graduates, activities of their technical society student chapter, and co-op, internship or research opportunities for their students. After this approximately 15-minute introduction, questions asked by the introduction to engineering students steered the discussion.

6. Course Assessment

Our introduction to engineering course supporting our hybrid model was piloted in 2014. Twenty-one students enrolled in the course. In this section, we focus on our preliminary assessment, which includes initial assessment related to student understanding of differences between various engineering disciplines, student perceptions of the entire course, and reflections of the six instructional faculty who led the course.

6.1 Pre/post-course concept maps

Concept maps can be thought of as a graph where nodes represent concepts and links between nodes represent relationships. Links are typically labeled with connecting phrases or verbs. Concept maps have been previously used in engineering education to assess students' concepts of their discipline and domain-level expertise (e.g., [10,11]). For our purposes, we analyzed students' pre/post-course concept maps to assess students' understanding of the differences between disciplines.

We initially trained students on the process of creating concept maps during an in-class exercise on the first day of class. We utilized Cmapper.Learn documentation available at www.cmappers.net and asked student teams to construct a concept map of the university [12]. Students created their concept maps using small note cards which where then adhered to a large sheet of paper and displayed on the wall. Student teams then viewed other teams' concept maps in a peer review session. Following this initial training, we required students to create an individual concept map of engineering. In the last week of the course, we required students to create a second concept map of engineering using identical instructions. To evaluate students' concept maps, we based our scoring rubric on a previously published holistic concept map rubric[13], and evaluated concept maps for comprehensiveness, organization and correctness. Using the holistic rubric, concept maps can be rated 1- to 3-points per category with a 9-point maximum score.

Fifteen students completed both concept map assignments. Each concept map was scored independently using the scoring rubric by a single evaluator. In all cases, the concept maps reflected limited knowledge of the engineering discipline and no concept map was rated higher than 6-points. However, in 12 of 15 cases post-concept maps were rated higher than pre-concept maps. In one case, the pre-concept map was rated higher than the post-concept map, and in the remaining two cases, the pre- and post-concept maps were rated identically. We did not conduct statistical comparison of the concept map scores due to the small number of participants.

These initial results are not surprising as one would expect that students' knowledge of engineering would increase after completing an introduction to engineering course. Further, experiences other than course experiences (e.g., attending technical society student chapter meetings) could influence students' understanding of engineering. Encouragingly, it was observed that many of the new concepts and connections on students' post-concept maps were directly related to course activities.

6.2 End of the semester survey

We used an end-of-the-semester survey to measure the impact of various components of the course on students' engineering major selection decisions. The survey contained open-ended (qualitative) and 5-point Likert-type scale (quantitative) questions. We focus our discussion on the quantitative questions.

Nineteen students completed the survey. The ten quantitative questions and average student responses are listed in Table 3 with "1" indicating strongly disagree and "5" indicating strongly agree. In general, students were positive about the course with 16 survey participants indicating they were happy or very happy with their decision to enroll in the course (Q10). Two students disagreed with the statement and one student was neutral. Students agreed that they met the learning objectives for the course (Q1-Q3). Students believed that the engineering modules promoted a better understanding of differences between engineering disciplines (Q4-Q7) with the process engineering laboratories receiving the most favorable response. Students preferred the hands-on laboratories to panel sessions. However, in a follow-up question, students indicated that they liked the variety and future courses should continue to use both forms of instruction but with a panel timing modification. The panel sessions were intermingled to reduce monotony, but in retrospect panels should be scheduled in the first half of the course so that students are exposed to each engineering degree program before spring semester advising and course scheduling begins.

Table 3. Likert-scale survey questions and student responses

Question	Average Rating
Q1. As a result of this class, I am able to articulate the fundamental differences between the engineering majors offered at Mississippi State University.	4.3
Q2. As a result of this class, I am able to work in a team environment to solve engineering problems.	4.8
Q3. As a result of this class, I am able to write technical communications for various audiences.	4.2
Q4. The **departmental panel sessions** helped me understand the differences between engineering disciplines.	4.1
Q5. The **engineering mechanics laboratories** helped me understand the differences between engineering disciplines.	3.5
Q6. The **process engineering laboratories** helped me understand the differences between engineering disciplines.	4.3
Q7. The **product dissection laboratories** helped me understand the differences between engineering disciplines.	3.8

Q8. I prefer panel sessions to learn about different engineering disciplines.	3.5
Q9. I prefer laboratories to learn about different engineering disciplines.	4.1
Q10. In retrospect, I am happy with my decision to enroll in GE 2990 rather than a discipline-specific introduction to engineering course.	4.3

7. Conclusion and Future Work

Our initial pilot of our hybrid engineering matriculation model was well received by engineering students who enrolled in our general introduction to engineering course and concept maps indicate gains in student knowledge. Assessment of the pilot is continuing with a qualitative analysis of open-ended survey questions and an investigation into student demographics such as retention tracking. We are planning a revised course offering in the Fall 2015 semester that will allow for additional data collection from students and from university personnel regarding our hybrid model implementation and introduction course offering. Additionally, with an eye towards revising the course for the Fall, we are planning a Spring 2015 survey of department heads, introduction to engineering instructors within each of the departments, and academic coordinators within each department.

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