

Transitioning Students into BAE from a Common First-Year Engineering Curriculum - A Work in Progress

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Abstract

In Fall 2016, a new First Year Experience (FYE) was implemented for all incoming engineering students at the University of Kentucky, resulting in a restructuring of our curriculum during the sophomore through senior years and eliminating two departmental freshman courses previously used to introduce the students to our discipline, its specialization pathways and problems typically encountered by biological and agricultural engineers. While the FYE should lead to students making more informed decisions about their choice of major resulting in higher retention rates within each major, it also means the departments have one less year of contact with students.

To combat lost contact time, a new introductory course was developed for first semester sophomores. The introductory course is divided into modules, each detailing a design problem from the different specializations within BAE. Each module explains a number of basic concepts related to the design problem. Students are asked to develop solutions to real-world design problems to explore the specialization areas within the discipline, practice their problem-solving skills on real, sometimes "messy" problems, grow their engineering intuition and learn to distinguish between realistic and improbable solutions. Students will compile a learning portfolio throughout the semester documenting their design solutions for each module, as well as self-reflections on their initial choice of specialization and the impact modules had on their choice of specialization (either confirming their initial choice or providing evidence why an alternative may be a better fit).

The intended advantages of this proposed arrangement is four-fold. (1) Students will be prepared to make a more informed decision regarding their selected area of specialization, leading to a more straightforward path to graduation. (2) Content will preview topics and information that students will see again in upper-level engineering courses, providing a scaffold framework to aid in their transition to becoming more autonomous and engaged learners. (3) Students will practice working with open-ended problems in a low-stakes environment, building their confidence for making sound engineering decisions. (4) Students will begin developing a portfolio of design experiences in a variety of areas to draw upon as they progress through the curriculum, leading to a broader, systems-approach to solving engineering problems.

Specialization selection and graduation data, surveys, and self-reflections will be used as assessment tools to determine whether this approach contributed to students' abilities to make informed decisions about specialization choice, to build upon their previous experiences to grow their engineering intuition and to discern between realistic and improbable engineering solutions. Average time to graduation of BAE students, as well as the percent change in initial and final choice of specialization for students from before and after this course was implemented, will be compared to determine the impact this course has in student decision making.

Introduction

A new First Year Experience (FYE) was implemented by the College of Engineering at the University of Kentucky in Fall 2016 for *all* incoming engineering students. Students no longer declare their discipline-specific major at the time of admission; they are simply designated as engineering students. The first two semesters have been redesigned so that all engineering students take the same set of courses, which include two semesters of calculus, one semester each of chemistry and physics with lab, and three courses that meet general education university requirements, in addition to three new "custom-designed" courses that explore all engineering disciplines offered at this institution. Students do not declare their specific majors until partway through the second semester (when registration for the following fall semester begins). The three new custom-designed courses are structured to introduce students to the creative processes inherent in engineering design, while gaining hands-on experience with the design process.

The shift to a common first year has many advantages. The FYE is intended to provide students with an interdisciplinary view of engineering from the very beginning of their undergraduate coursework, exposure to different perspectives, and experiences in the various engineering disciplines, with the anticipated outcome that students will be better prepared to make a more informed decision about their intended major. The last five College of Engineering cohorts (2011-2015) had retention rates approaching 70% within the college; however, that figure does not indicate the amount of movement observed from one engineering major to another. Anecdotal evidence seemed to indicate that the top offenders in student retention at this institution were traditionally engineering majors, with the students often switching to other engineering disciplines. For students who know they want to be an engineer, the FYE should help them make an informed choice about their major, which could lead to better retention rates within the majors and the college; give the students some knowledge of what is to come when pursuing a specific major; and reduce the time and expense associated with changing majors, even when changing between engineering majors.

Another potential benefit of the FYE on which we hope to capitalize is that students will come into their declared major with a full year of fundamental coursework completed. By already having some of those foundational courses completed (i.e. calculus, chemistry, physics), the applications and examples introduced in BAE coursework can be more advanced, including complex systems, than what was previously included in our introductory BAE courses. Since all students will have had the same set of courses prior to taking their first BAE course, we can also begin moving them toward higher levels of Bloom's taxonomy and preparing students with the type of learning skills they will need in upper level engineering courses in a way that was not always possible when they were first semester students.

Lastly, the introduction of the FYE has provided us the opportunity to re-envision our curriculum and be more intentional with course design during the sophomore through senior years. For example, we can introduce more scaffolding within the curriculum to prepare students for coursework and topics they will encounter later in the program. Skills learned in the first year will be incorporated into second year courses and so on, so students can continue to grow their engineering toolkit. However, reorganization of our existing curriculum has also presented

challenges. We have critically examined all of our course offerings and made changes where necessary to continue preparing our students well for an engineering career after graduation.

Several other disadvantages have been recognized with the implementation of the FYE. One downside of the FYE program is departments lose a year of contact time with students. Two freshman year courses previously taught in-house for BAE students are no longer offered, meaning that BAE students and faculty lose out on a full year of building meaningful professional networks. BAE faculty meet students later, and students interested in majoring in BAE, as well as current BAE students, may not meet one another until later, unless the new student is motivated and courageous enough to reach out on their own during that first year. These professional relationships often lead to faculty recommendations of students for co-ops, internships, scholarship programs or graduate programs. We are also noticing a lack of continuity and participation in our student organizations, since students are not physically here in the department as in previous years. It is unclear still how these networks may be affected, and it may take several more years to realize some of these unintended consequences of moving students away from specific disciplines in that first year.

It is also important to ensure the FYE instructors understand the BAE discipline well enough so that relevant examples and projects are incorporated into the FYE engineering courses. In order for this program to receive the college-wide support needed to be successful in its adoption, it was imperative to assemble a core set of FYE instructors with the breadth necessary to represent all engineering disciplines. While BAE has excellent representation within this core group of instructors, we must still be proactive in bringing awareness to the BAE discipline to both the instructors and the students.

In order to combat the lost contact time, we have proposed a new sophomore level course to introduce students to the various specialties within our program, to continue practicing their problem-solving skills on discipline specific problems, and to grow their engineering intuition about realistic and improbable solutions by having them develop solutions to real-world design problems.

Learning theories and instructional systems

Learning is a multidimensional process, incorporating motivational, cognitive, social and affective components (Lee & Hannafin, 2016). *Self-determination theory* provides explanations regarding the relationship of autonomy and motivation (*why students want to learn*). *Constructivism* offers perspectives on how learners navigate new information and make meaningful connections (*what students learn*). *Constructionism* promotes the application of ideas and concepts to construct and present a concrete artifact as another dimension of learning (*how and with whom the student engages in learning*). *Transformative learning* provides a metacognitive view of learning (*how the student learns*). The following sections discuss some of the underlying learning theories and instructional systems from which we have drawn during the development of the proposed course.

Self-determination theory

Autonomy, competence and relatedness constitute three supporting pillars of self-determination theory, which have been shown to influence motivation (Lee & Hannafin, 2016). Motivation can range from extrinsic in nature (i.e. motivated by grades or other external, pre-defined performance indicators) to intrinsic in nature (i.e. personal interest in or novelty of topic).

Autonomy has been defined as the need for an individual to take ownership of their behavior (Van den Broeck, Ferris, Chang, & Rosen, 2016). Studies have shown that students become more intrinsically motivated to learn when they are able to make decisions about course content and move toward more autonomous behaviors, as a sense of choice adds to their perception that they are in control of their learning environment (Deci & Ryan, 2000; Lee & Hannafin, 2016). Autonomy is a desirable behavior for students to obtain. Autonomous students typically want to engage with new material and be exposed to new experiences because of their intrinsic motivation, which leads to a more positive learning experience for both the student and the instructor. Students who engage with material, have a deeper, more meaningful understanding of the material and shift their learning from lower to higher levels on Bloom's taxonomy.

Autonomy is an especially important characteristic for engineering students, where creativity and flexibility are necessary to solve complex problems. Deci and Ryan (2000) found that intrinsic motivation, in conjunction with providing options and recognizing self-initiation of tasks, led to more creative and positive outcomes to complex problems. In engineering capstone courses, students often balk at the reality that real-world design problems are messy, ill-defined and have more than one solution. The uncertainty in and lack of confidence of the problem-solving approach and lack of creativity in solution development are apparent, especially after taking numerous courses where they were expected to solve straightforward, pre-packaged problems following a prescribed methodology to arrive at a single correct answer.

Constructivism

The foundational idea of constructivism is that knowledge is "constructed" by the learner. Teachers support student learning rather than direct their learning (Parmaxi & Zaphiris, 2014; Weimer, 2013). In this sense, students must explore and engage with the material on a deeper level in order to make meaningful connections between new information and what they currently know.

The core components for creating opportunities for constructivism to flourish are students working in groups on open-ended problems and tasks; discovering, accessing and organizing information; and formulating their own solutions (Lee & Hannafin, 2016; Weimer, 2013). These components align nicely with the engineering design process, where a problem is identified, information is gathered, and a solution is formulated.

Constructionism

Where *constructivism* focuses solely on the cognitive processes of learning, *constructionism* goes one step further with the addition of creating a concrete artifact to aid in the construction of

knowledge (Parmaxi & Zaphiris, 2014). The hands-on experience of creating a concrete artifact not only illustrates understanding and synthesis of relevant information, but it allows for learning to occur at multiple points in the process. For example, learning happens during the construction phase and also when presenting or discussing the artifact with others (Lee & Hannafin, 2016). These interactions and connections with knowledge are what make abstract concepts and ideas more concrete. Students must use information and skills they have learned to construct their artifact. They must further engage with the created knowledge and an authentic audience when presenting or discussing their artifact, which strengthens their personal investment and solidifies their understanding.

Transformative learning

Learning becomes transformative in nature when we reflect on what was learned and how it has changed us personally. Metacognition is the awareness of and thinking about one's own thinking (McGuire & McGuire, 2015). Transformative learning happens when students move to higher levels of Bloom's taxonomy, but this shift will likely take work from both the student and the instructor. Students not accustomed to engaging with material at the levels required to learn something independently may need support to successfully transition to and perform at these levels consistently. McGuire and McGuire (2015) argue that students understand the concept of Bloom's taxonomy when it is introduced to them. Students recognize that they need to move beyond the lower levels (i.e. remembering, understanding, applying) that may have been adequate to succeed in high school and to perform at the higher levels (i.e. analyzing, evaluating, creating); however, they may not know how to make that leap if they have never had that experience. Metacognitive activities integrated into course assignments are a good way to encourage students to think about how they think and practice some of the higher-order learning skills. Connell, Donovan, and Chambers (2016) have shown that incorporating writing assignments with metacognitive components seem improved student learning. Reflecting on one's own thought processes can improve one's ability to learn, which can shift students to a higher order of thinking skills.

The "Own It, Learn It, Share It" framework

The "Own It, Learn It, Share It" (OLSit) framework proposed by Lee and Hannafin (2016) draws upon aspects of self-determination theory, constructivism and constructionism to promote student engagement in the learning process. The OLSit framework provides a set of guidelines to ensure various dimensions of learning are incorporated into course design. We have adapted this framework, with the addition of metacognitive features, as the basic structure of our new introductory BAE course.

Course framework

The course is constructed of stand-alone modules, with each module culminating in a level-appropriate design project. When developing the modules, we used the guiding principles listed in Table 1 for selecting the project subject material. Examples detailing the implementation of these guiding principles in a course module are given in the subsequent text.

Table 1. Guiding principles for developing each design module.

Scaffold on first year science and math courses.

Expand the science concepts into engineering science principles that the students will see again in their subsequent classes.

Demonstrate where biosystems information and knowledge specifically informs the design.

Require meaningful calculations to assist with the design (using basic and engineering science).

Scaffold on first year science and math courses.

Our students will all have completed the first semester of general chemistry, using the textbook *Chemistry: A Molecular Approach* (Tro, 2014). Chapter 6 of this textbook, entitled *Thermochemistry*, covers the basic science needed to understand the engineering science taught in the sample module outlined later. Key ideas and concepts from this chapter include heat, thermal energy, system versus surroundings, the law of conservation of energy, the first law of thermodynamics, and the heat of reaction and change in enthalpy for a chemical reaction.

The students will also need to understand the concept of derivative and anti-derivative learned in their first calculus course.

Expand the science concepts into engineering science principles that the students will see again in their subsequent classes.

The engineering science principle to be taught in this module is conductive heat transfer through a wall, which the students will see again in their heat and mass transfer course, their principles of process engineering course, and their structures and interior environment course. The derivation of the equation for rate of heat transfer through the wall requires solving using a simple anti-derivative (some students will have covered integration in Calculus II, but it is not a prerequisite for this course).

Physical properties of materials (like thermal conductivity) will also be introduced.

Demonstrate where biosystems information and knowledge specifically informs the design.

One of the terms in the energy balance equation is rate of heat generated by the system, and in order to calculate this term the students will need to understand that the Basal Metabolic Rate (BMR) is a summation of heats from all chemical and mechanical processes that must occur to sustain life at a very low level. BMR, which can be calculated, varies with body mass and species. The heat generated by muscle contraction (physical activity above BMR activity) is also quantifiable and important for our energy balance.

The challenge of obtaining physical properties of biological materials will be discussed.

Require meaningful calculations to assist with the design (using basic and engineering science).

The students are asked to perform several calculations to answer the following question: Which sustainable building material (straw, mud, or bamboo) is the most efficient/economical to heat? Can we heat a tiny house with just metabolic heat from the people living there? Heating efficiency/economy will be a function of the resistance of the wall to heat flow, which is a property of the thickness of the material of the wall. Students will be asked to explore different wall thicknesses and graph how that changes their answers.

In addition to the guiding principles listed in Table 1, we incorporated activities that supported the “Own it”, “Learn it”, and “Share it” framework and these are summarized in Table 2.

Table 2. Supporting activities developed for an example module following the "Own It, Learn It, Share It" framework.

Framework	Guidelines	Supporting Activity
Own it	1. Facilitate endorsement of external goals	<i>Purpose of module:</i> Investigate the feasibility of using alternative materials for housing in a climate like our own. <i>Value of project:</i> Provide practical experience with sustainable construction materials.
	2. Provide opportunities to set specific personal goals	Ask students to write clear learning goals for themselves for module.
	3. Provide choices that matter	Students may choose between building with straw, mud bricks or bamboo.
Learn it	4. Provide explicit direction on initiating engagement	Scaffold review of background material (chemistry and calculus). Link that material with biology through basal metabolic rate, and expand to teach domain-specific knowledge such as conservation of energy and steady-state heat transfer through a wall.
	5. Support the selection and use of tools and resources	<i>Tools and resources:</i> Make visible the unobserved thought processes Excel spreadsheet Straw bale building Mud brick laying
	6. Prompt to support varying needs	<i>Conceptual prompts:</i> Ask questions related to heat transfer calculations and physical properties of materials.

Procedural prompts: Are you writing out equations before entering them into Excel? Are you testing accurate syntax with hand calculations?

Metacognitive prompts: Are you meeting your learning goals? Can you talk through your thought process for decision making?

	7. Integrate the terminology used in the discipline	Heat transfer terminology Engineering science as used in design
	8. Support students as they monitor progress	Are they using engineering science to inform their decisions or just intuition?
Share it	9. Promote dialogue among students and audiences	Group presentations on which house they prefer; testing of houses in different climates
	10. Facilitate helpful peer review	Review results; debrief decisions based on experimental results.

Example module: Designing a tiny house from sustainable building materials for our local climate.

Own it: Example module

Design guideline 1: Facilitate endorsement of external goals.

As biosystems engineers, some of the biggest challenges that we are trying to solve involve using our natural resources as sustainably and responsibly as possible. This activity will get students to think about sustainable construction materials and how climate and building materials interact to impact the comfort associated with interior environments. Initially, we ask the students for examples of sustainable building materials to get them thinking about what it means to be sustainable and what materials are available for constructing buildings and homes. After compiling a list of materials, we show examples of bamboo, mud, and straw homes similar to those show in Figure 1, and ask students whether they think they would be comfortable living in these homes. Examples of “luxury” bamboo, mud and straw homes can be used to get additional feedback from students about comfort level. We can also steer the discussion to the types of climates in which these homes are typically constructed and present the question of whether or not these types of homes could be built in our local climate.



Figure 1. Examples of houses made from (left to right) bamboo, mud and straw. (Photos of bamboo and straw homes courtesy of Creative Commons licensing. Photo of mud house courtesy of Bdx.)

Design guideline 2: Provide opportunities to set specific personal goals

Students will be asked to reflect on what goals they want to work towards for this module. These goals might be to learn more about construction materials or techniques or to practice their public speaking skills by reporting on group progress. By setting goals for themselves, we want to get them accustomed to practicing this reflective part of the learning process.

Design guideline 3: Provide choices that matter

During the labs, students will experience building models of tiny houses out of either mud, straw, or bamboo. At the end of this project, students will select the building material for a tiny house that they think will work best for our climate based on the material's thermal properties and estimated cost in dollars and to the environment.

Learn it: Example module

Design guideline 4: Provide explicit direction on initiating engagement

Students who have not experienced taking basic science knowledge and applying it to engineering design will need explicit direction at first to initiate engagement with the design problem at hand. A review of background material from chemistry and calculus course taken in their first year will be used to get students to think about concepts relevant to selecting construction materials for a house. Concepts from chemistry (i.e. energy, work, heat, the law of conservation of energy, units of energy) and calculus (i.e. derivatives and anti-derivatives) will lead into discussion of specific domain knowledge concepts (i.e. energy balances, heat generation, and basal metabolic rates). Table 1 gives a sample outline for a class discussion.

Table 3. Outline of class discussion to review knowledge from previous courses and new, domain-specific knowledge needed for selecting construction materials.

Concept	Definition or Example
<i>Basic Science Knowledge</i>	
Energy	The capacity to do work
Work	The result of a force acting through a distance
Heat	The flow of energy due to a temperature difference
Types of energy	The energy contained in a rolling billiard ball is an example of <i>kinetic Energy</i> (energy associated with the motion of an object). The energy in a hot cup of coffee is <i>thermal energy</i> , the energy associated with the temperature of an object. Thermal energy is actually a type of kinetic energy because it arises from the motions of atoms or molecules within a substance. If you raise a billiard ball off the table, you increase its potential energy. <i>Chemical energy</i> , or the energy associated with the relative positions of electrons and nuclei in atoms and molecules is also a form of potential energy – released upon chemical reaction.
Law of Conservation of Energy	States that energy can be neither created nor destroyed, but can be transferred from one object to another and can change form. To track energy changes, we need to define the system . The system's surroundings are everything with which the system can exchange energy. Energy is transferred between the system and the surroundings.
Units of energy	Kinetic energy = $KE = \frac{1}{2} mv^2$. The symbol m represents mass (in kg) and v is velocity (m/s) so the units of KE are $kg \cdot (m/sec)^2$ or $(kg \cdot m/sec^2) \cdot m = N \cdot m = \text{Joule} = J$. How much energy is in one joule? A 100-watt lightbulb uses $3.6 \times 10^5 J$ in one hour (so a joule is pretty small in the grand scale of energy), so we typically work with $kJ = 1000 J$. Another commonly used unit of energy is the calorie (cal), originally defined as the amount of energy needed to raise the temperature of 1 g of water by 1°C but is now defined as 4.184 J (exactly) so a calorie is about 4 times larger than a joule. Remember that we think a joule is really small – so is a calorie – so there is another unit called the Calorie where 1 Cal = 1000 cal. Instead of just using the kcal you will also see Cal. Which unit is the one used to quantify the energy in food? [Calorie – it takes 100 Cal to run a mile]
Derivatives and anti-derivatives	As used in the derivation of the temperature profile within a wall
<i>Domain Specific Knowledge</i>	
Energy balance	(Rate of heat in) - (rate of heat out) + (rate of heat generated in the space) = rate of heat stored

	Rate of heat generated (in the space) represents human and animal heat production.
Sources of heat production	Three sources of heat produced by humans and animals: a) Basal Metabolic Rate: summation of heats from all chemical and mechanical processes that must occur to sustain life at a very low level; b) Food ingestion heat production; and c) Heat produced by movement.
Basal Metabolic Rate	This relationship has been summarized in an equation: $BMR = 3.39m^{0.75}$ BMR = basal metabolic rate (W) m = body mass (kg)

Design guideline 5: Support the selection and use of tools and resources

Engineering students need to practice selecting and using various tools and resources during the design process. We can encourage these habits by having them practice with commonly used tools. One way might be to have them use Excel to answer questions (Figure 2) about how the BMR affects their design. Similar material is presented for (1) heat generated by a human or animal and (2) heat generated by the food ingested and muscle activity.

Exercise: Human BMR is a function of temperature. At higher temperatures, our BMR increases and at low temperatures our BMR increases.

Room Temperature °C	Metabolic Rate (W)
0	115
10	101
20	84
30	87
40	89
45	91

Using Excel,
a) plot the relationship for Metabolic Rate as a function of temperature, and
b) convert to English units and replot.

Figure 2. Sample exercise to incorporate practice of commonly used tools in engineering design.

Guideline 6: Prompt to support varying needs

Prompts encourage students to think about information in different ways that can support construction of new knowledge. Conceptual prompts, procedural prompts and metacognitive prompts can guide students' thinking and model habits that lead to more independent learners. Conceptual prompts ask questions regarding heat transfer calculations and physical properties of

the materials. Procedural prompts may emphasize the importance of “thinking before doing” by gently reminding students write out equations by hand prior to entering them into Excel. Metacognitive prompts reinforce the importance of reflecting on one’s progress, goals, and thought processes.

Design guideline 7: Integrate the terminology used in the discipline

Following discussion of the basic science from previous courses with the important biological aspects of the design, heat transfer terminology will be introduced. We will discuss conduction, convection and radiation, properties of construction materials (i.e. conductivity and resistance to heat transfer), and the biological contribution to heat transfer (i.e. heat generation by people), and the impacts of each of those concepts on the house design.

Design guideline 8: Support students as they monitor progress.

At this point in the module, it is important to encourage students to reflect on their progress. We will ask them to look critically at how they are approaching their house design. Are they using engineering science, their intuition or a “wait and see” approach to inform their decisions. A checkpoint we might implement is to ask the students whether that can heat their house with only the people living in it. Figure 3 contains questions we can use to encourage discussion.

Question: Are students using engineering science, their intuition or a “wait and see” approach to inform their decisions?

Activity: Can we heat this house with just people?

We have two ways we can approach this problem.

- 1) Build the house, put it outside in the winter and summer, and see if a person can survive the elements.
- 2) Use what we know (basic science and engineering sciences) to calculate whether or not a person could survive; pick the most promising house, build it and then verify.

Why would you pick method 1 over method 2? (*Ask for student input.*)

- a) Don’t know the science.
- b) Don’t want to bother with the calculations; don’t want to think it through.
- c) Have lots of extra money laying around.

Why would you pick method 2 over method 1? (*Ask for student input.*)

- d) Saves time and money (and in some projects, people’s lives).
- e) You have a sound BAE education and understand the value of planning before building.

Which way are you approaching the problem?

Figure 3. Discussion questions to encourage students to reflect on their approach to designing their home.

At the end of the module we will quantify the heat flow through the houses built, using students as the heat source and measuring the temperatures inside, interior of the wall, exterior of the wall, and in the ambient air. Students will be asked to reflect on how these results matched the results they predicted with their calculations.

Share it: Example module

Design guideline 9: Promote dialogue among students and audiences

One of the first assignments is for the students, working in groups, to prepare a short presentation of houses made from sustainable materials that they like and concluding with a prediction of which material will be the most heat efficient material for our climate. Following the presentations, the class will have a group discussion to collect the students' ideas regarding how to construct and test the tiny houses.

Design guideline 10: Facilitate helpful peer review

At the end of the module students will exchange Excel spreadsheets for peer review. The intent of this review is two-fold. First, the exercise gives each student some feedback on their Excel sheet separately from the instructor's review, and secondly, and possibly more important, the student who is doing the critiquing quickly sees how important it is to properly set up a worksheet, and to label their work so that someone else can follow what they have done. We have not found any better way to transmit this lesson to the students.

Assessment Strategies

Assessment is a critical step in validating whether the student learning outcomes associated with this course are occurring and whether the long-term departmental retention and graduation goals are supported by this course. We plan to compare progress through the BAE program between groups of students who took our two freshmen introductory courses taught in-house in previous years to groups of students who participated in the FYE and the new introductory course described here. Data collected from the two previous cohorts (2014 and 2015) will be used to determine retention and (eventual) graduation rates, and also initial and final specialty selection. Average time to graduation of BAE students, as well as the percent change in initial and final choice of specialization for students from before and after this course was implemented, will be compared to assess the impact this course has in student decision making.

Additionally, student survey data will be collected at the beginning of the new course to gauge pre-existing perceptions of the biosystems engineering discipline, its areas of specialization, and the students' ability to recognize reasonable engineering solutions. Students will be asked to indicate which specialty area they intend to choose. Self-reflections will be used throughout the semester to monitor students' thought processes regarding their specialty selection. A final survey will be administered to gauge student perceptions after having completed this course. Student progress to graduation and specialty selection will also be tracked long-term. We intend

to follow best practices for data collection procedures and are subject to IRB approval prior to the start of data collection in the Fall 2017 semester.

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