Specific learning objectives for sustainability

I would like my students to learn how their design choices have social, environmental, and economic impact. I would like them to understand that these considerations are coupled with the user experience and that early considerations of these could lead to a better user experience that also optimizes environmental impact. Additionally, I would like them to understand how designing for sustainability could influence their design itself. For example, designing for sustainability might imply that if they are building a component of their vehicle that joins two pieces of two different materials, they might want to make sure that the two pieces can come apart (so they can be disposed/reused/recycled easily at the end of use term of the product). This has cascading impact in decision for how to design the pieces, what kind of technique to use to interface the two pieces (using interlocking parts versus glue versus Velcro versus tape, etc.), how much time and effort is needed to break them apart, and how to label the individual components to make it easier for an end user to properly recycle the parts or dispose them at the end of life of the product. Thus, the sustainability ideas that I would like to focus on in my course are:

1. Systems thinking
2. Cradle to Cradle versus Cradle to Grave design

Assessment:

1. Coarse-grained assessment of student **buy-in** into sustainability: in ENES100, there is a award for the most sustainable design. Historically, it has been difficult to get teams to aim for this award. First introduced in Fall 2013, this award had no team competing for it that semester. In the next few semesters, only 2-3 teams (out of 60-70 teams!) have competed for the award. As a coarse grained measure of whether students are more excited about sustainability as a design practice, I will want to measure what % of my students want to compete for this award. I will build data on this measure over a few semesters. (I will be sharing the materials with other instructors, and those instructors who decide to include the sustainability criterion in their sections will also be included in the data set).

2. Meso-scale assessment of **learning** of sustainability concepts: In order to determine if students are learning sustainability ideas I will code their preliminary design reports and final design reports. With 5 teams in my section, I will have 10 reports per semester, and 20 total reports over the next year. In their reports, I will see if students are citing sustainability concepts as constrains for their design. For each warrant, I will code if they are drawing on systems thinking or cradle-to-cradle/cradle-to-grave ideas or some other sustainability idea. As a very coarse measure, just knowing at what frequency these ideas show up in their report will provide feedback on whether I am being comprehensible to the students in my

instruction. For a slightly deeper assessment, I will code if each concept is (i) well articulated and (ii) being applied correctly and (iii) if it leads to actual change in design/practice or is discarded after consideration. The coding scheme for these three categories will be refined after the first semester. The particular manner in which I discuss sustainability concepts in the class in the second semester will also be refined based on the results of this coding from the first semester. In the spirit of formative assessment, for the preliminary design report, each semester, I will write extensive comments as feedback on how students are using sustainability concepts for their design thinking and where I see missed opportunities for incorporating these concepts.

In subsequent semester (starting Fall 2016), I will continue to refine the coding scheme and instruction. And I will explore if I can collect observational data on students to be able to assess their reasoning about sustainability at a finer scale.