



## Learning Expectations and Outcomes for an Engineering Leadership Principles Class

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## **Abstract**

Many institutions have advisory groups who offer advice on curricular issues, such as academic objectives and industry needs; however, students' educational expectations are often absent from this definition process. The purpose of this paper is to provide insight into student leadership learning expectations and measured performance. This study addresses these issues by recording student expectations for an engineering leadership principles class. The study then places these expectations within the perspective of the defined course learning objectives.

Data were collected in the introductory engineering leadership class at the Pennsylvania State University. Across three academic semesters, a total of 79 students took both the pre-course and post-course leadership principles survey. The goal of this survey was to understand how students perceive their learning of characteristics related to leadership. Additionally, a student expectations assessment, whereby students were asked what three different leadership attributes they would like to develop, was collected from the same student class cohorts. The five most frequently listed student-reported expectation attributes were: (1) confidence, (2) communication ability, (3) trust in team members, (4) ability to inspire-motivate, and (5) ability to exercise sound judgment. The average student response on the leadership principles survey from pre-course to post-course for all five student-identified learning expectations shifted in the anticipated direction of response, which indicates the class positively changed students' reported leadership principles efficacy. There is a strong relationship between student-identified learning expectations and improved understanding of the related leadership principles course content.

## **Introduction and Background**

Although broad consensus exists regarding the value of leadership skills development in 21<sup>st</sup> century engineering education, many engineering schools that identify leadership development as part of their educational mission lack a functional mechanism by which to accomplish this goal.<sup>1</sup> Those institutions in which engineering leadership education is explicit are able to rely, in part, on fundamental traditions of leadership pedagogy, but are also confronted with discipline specific needs and a rapidly changing world. Given the breadth of the engineering profession, and the lack of an engineering leadership domain definition, specific program objectives in place today depend in large part upon the worldview of those administering the program or teaching the course. A literature review on the topic revealed a broad field of perspectives indicative of the early stages of domain definition.<sup>2</sup> Thus, program facets related to engineering leadership (e.g., innovation and technology product design, and managing complex systems) require program-specific assessment to determine efficacy. Other outcomes such as knowledge of leadership theory, leadership skills, and project planning may be common components assessable across programs.

Many colleges have industrial and professional advisory groups that offer advice on academic issues and industry trends and needs.<sup>3</sup> Some researchers indicate feedback solicitation from seniors and alumni provide useful retrospective insights on perceived abilities, competencies,

and value of the curriculum.<sup>4</sup> The special interests, expertise, and prospective needs of an audience, however, are critical to successful communication.<sup>5</sup> While audience interests and needs seem intuitively important, there is a significant absence of literature addressing the topic of expectations that engineering students hold about the outcomes of their education. For example, evaluation of teaching at the end of the semester usually offers students the opportunity to comment on the improvement of instructor teaching and existing course content; while the opportunity to provide this type of retrospective feedback is perceived by students to be of value, it does not provide explicit guidance with respect to curriculum expectations.<sup>6</sup> Other studies have assessed students' expectations regarding the engineering profession in order to measure high school student interest<sup>7</sup> or undergraduate retention within a university college.<sup>8,9</sup> One researcher focused on the value of interpersonal relationships with students and real-time feedback on teaching *methods*, but not content.<sup>10</sup>

The goal of the present study was to systematically record student-identified learning expectations and compare these expectations to their understanding of leadership principles. For the purpose of this paper, we define “student expectations” to mean those learning outcomes students aspire to, hope for, plan to acquire, hence *expect* from the class; in essence the reason they registered for the class and what they *expected* to learn from the class.

This study evaluated the teaching effectiveness of a 2-credit gateway course for the engineering leadership development minor at the Pennsylvania State University (Penn State). The course, “Leadership Principles”, was designed to introduce students to the fundamentals of leadership, including: self-awareness, team skills and motivational strategies, cultural sensitivity and the value of diversity, organizational leadership, innovation, decision making, and judgment. The course is delivered by faculty and accomplished industry leaders and includes reading assignments of key, related articles. Student engagement is encouraged and assessed in-class by frequent class presentations, exercises, and discussions as well as outside of the classroom by having the student document their insights gained for each topic covered. Furthermore, team projects are assigned throughout the course in order to provide students with opportunities to exercise and reinforce the leadership skills that they have learned.

The course has evolved to its current state over the 18-year history of the minor. The leadership principles course is part of a minor that has been recognized in a recent global study as one of the best examples of explicit engineering leadership programs.<sup>1</sup> The minor and course are open to all engineering disciplines, and attract a limited number of non-engineering students, for a total enrollment in the minor of nearly 100 students. More than 80 students register for this gateway class per year, representing about 5% of the students entering the College of Engineering.

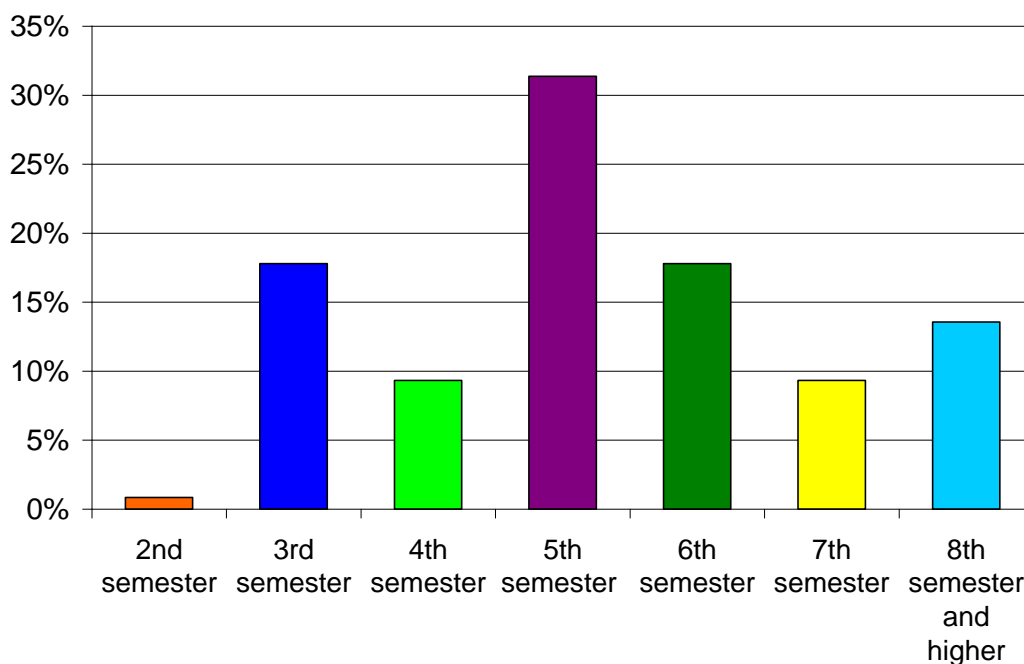
## Methods

*Participants.* Survey response data were collected from 118 students enrolled in the introductory engineering leadership class. This class serves as the introductory 2-credit class to an 18-credit minor in engineering leadership development that offers students a conventional track to completion as well as a global track consisting of courses with international collaboration and travel components. The data were collected across three different classes (fall 2010, spring 2011, and fall 2011 semesters) and collapsed to facilitate analyses. Note that all participant

demographic information was calculated using pre-course survey data. A pre-course survey ( $N = 118$ ) was administered prior to instruction and a post-course survey ( $N = 88$ ) was given at the end of the semester. More males (64%,  $N = 75$ ) than females (36%,  $N = 43$ ) were surveyed at the beginning of the course across the three semesters. Most of the student respondents indicated that they were *White American (not Hispanic)* (73%,  $N = 86$ ). Other ethnicities that students reported include: *Foreign (in US on student or temporary VISA)* (11%,  $N = 13$ ), *Black American (not Hispanic)* (6%,  $N = 7$ ), *Hispanic American (not Puerto Rican)* (6%,  $N = 7$ ), *Asian American or Pacific Islander* (< 2%,  $N = 2$ ), *Hispanic American or Puerto Rican* (< 2%,  $N = 2$ ), and *Puerto Rican* (< 1%,  $N = 1$ ).

The semester standing most frequently reported was *5<sup>th</sup> semester* (31.4%,  $N = 37$ ) followed by *3<sup>rd</sup>* and *6<sup>th</sup> semesters* (17.8%,  $N = 21$ ). Thus, the class was attended by mostly third year students followed by second year students. It is of note that, although most would have been nearing the end of their major program and unable to complete the minor program, fourth year students comprised roughly 23% ( $N = 27$ ) of the class. For further semester standing details, see Figure 1.

Figure 1: Semester standing of pre-survey respondents



When asked pre-course ( $N = 118$ ) and then again post-course ( $N = 88$ ) which minor track they planned on completing, the frequency of the students' responses shifted for some options. These responses are summarized in Table 1. There was an overall positive trend in students opting to pursue the minor and to pursue the global option.

Table 1: Participant intentions

	<b>Pre-Survey (N=118)</b>	<b>Post-Survey (N=88)</b>	<b>Difference</b>
Pursuing Minor	52%	63%	+11%
Not Pursuing Minor	14%	19%	+5%
Undecided	34%	18%	-16%
Pursuing traditional option	25%	22%	-3%
Pursuing global option	27%	41%	+14%

In order to better understand which students had denoted that they are pursuing the leadership minor, a cross tabulation was run for semester standing vs. minor option on the pre-course survey data. Of the students who completed the pre-course survey and indicated that they were pursuing the minor (i.e., global option or traditional option), less than 2% were first year, roughly 31% were second year, 50% were third year, and approximately 18% were fourth year students.

*Leadership Principles Survey.* The *Leadership Principles Survey* was developed in an effort to investigate how students perceive their learning of characteristics related to course-specific leadership learning objectives. Specifically, the survey was designed to measure students' perceptions of seven defined leadership competencies. The survey consisted of 65 core items, 6 demographic items, and 4 open-ended items. A 5-point Likert scale (i.e., strongly disagree = 1, disagree = 2, neither agree nor disagree = 3, agree = 4, strongly agree = 5) served as the item options and scale for the 65 core items. The core items were grouped into seven subscales. These subscales comprised the following categories: (1) understanding of ethical issues; (2) global awareness, world-view; (3) oral communication skills; (4) organizational/leadership skills; (5) self-knowledge; (6) creativity; (7) teamwork.

The educational objectives and outcomes for the program were previously reported<sup>2</sup> and are grouped in two categories: (A) skills and abilities, (B) knowledge and awareness. The skills and abilities outcomes for this introductory class are: enhanced communication skills (oral); ability to share leadership (teamwork); ability to exercise sound judgment. The awareness and understanding outcomes are: ethical awareness and conduct; self-knowledge and awareness (character); enhanced global awareness (world-view); enhanced appreciation of cultural diversity; understanding of public policy issues; understanding of contemporary leadership theories; understanding of the role of sustainability in engineering. These educational objectives were used in the development of the assessment instrument and also as a framework with which to correlate student learning expectations. The assessment data were correlated with student-identified primary learning expectations to both evaluate the efficacy of the assessment instrument and compare measured objectives with respect to student expectations.

*Student Expectations Assessment.* After completing two reading assignments during the first and third weeks of the semester, every student enrolled in the introductory engineering leadership class was asked to write one paragraph on each of three different leadership attributes/styles/qualities they would like to work on improving this semester. These assignments were designed to equip students with a common leadership vernacular with which to complete the assignment. To this end, each student wrote a roughly one-page response (approximately three paragraphs) on why they were taking the class.

Data Collection Procedures. Student responses to the *Leadership Principles Survey* were collected over three semesters (fall 2010, spring 2011, and fall 2011) and at two time points per semester: the beginning (pre-course survey) and end (post-course survey) of the academic semester. The survey was administered using Qualtrics, an online commercial survey package.<sup>11</sup> Survey data from these three semesters were collapsed yielding a pre-course survey sample size of  $N = 118$  student respondents and a post-course survey sample size of  $N = 88$  student respondents. When student responses across the three semesters were matched by the two semester time points, a total of  $N = 79$  students responded to both the pre-course and post-course survey.

Student responses for the *Student Expectations Assessment* were collected from fall 2009 through fall 2011 representing five semesters (fall 2009, spring 2010, fall 2010, spring 2011, and fall 2011) and  $N = 152$  students. This assessment took place as a homework assignment early in the semester after one class and two homework assignments intended to provide students with a common vernacular with which to respond to the questions. The question format was open-ended and the students were asked to write three short responses. Examples of student responses include:

- “Speaking in front of groups.”
- “Ability to entrust others with work.”
- “Prioritizing work.”
- “Communicating a vision.”

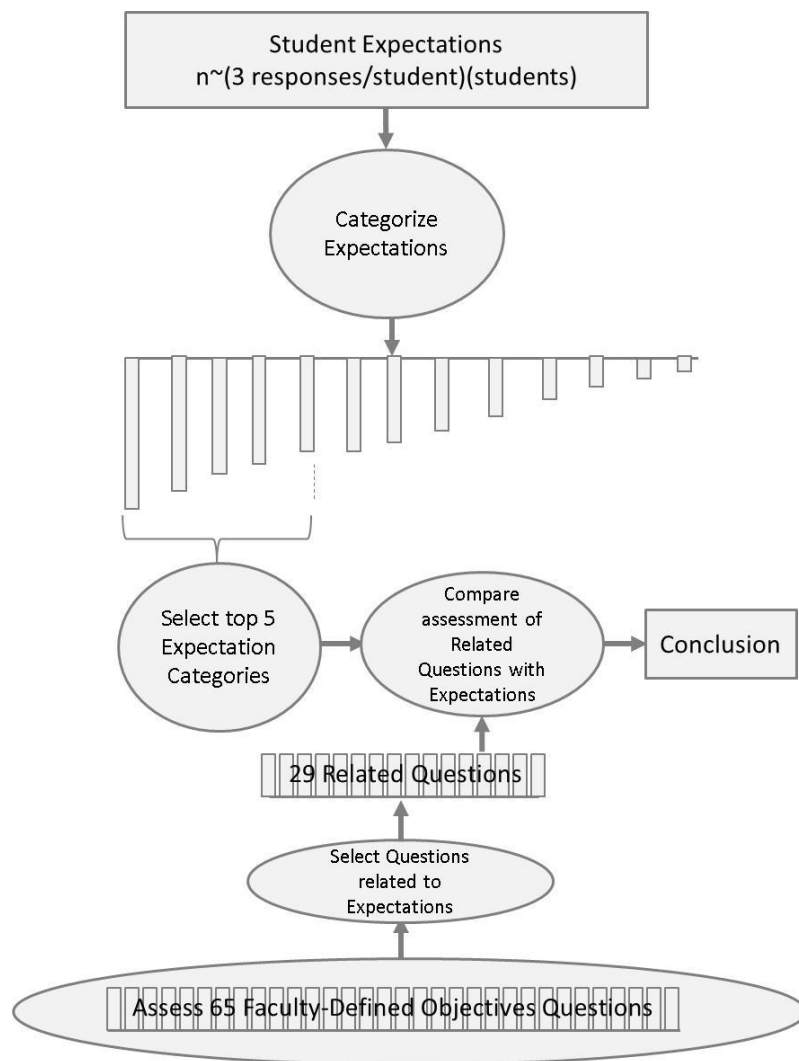
Data Analyses. The *Leadership Principles Survey* descriptive item response results were generated using a classical test theory program<sup>12</sup> as well as SAS software procedures (e.g., proc ttest). These item response results included response frequency, counts, and central tendency information. Paired  $t$ -tests, or dependent  $t$ -tests for paired samples, were run for each subscale on the pre-course and post-course student responses that had been matched, or paired, by student. The paired  $t$ -tests were generated for the seven subscales using SAS software. The family-wise significance level was used for all paired  $t$ -tests since multiple comparisons were made. Bonferroni adjustment, a multiple testing correction, for the seven subscales ( $.05/7$ ),  $\alpha = .007$  was the significance level used for each comparison between the pre-course and post-course survey data. This adjustment for multiple comparisons was made since the pre-course and post-course survey responses were compared for each of the seven *Leadership Principles Survey* subscales. Each time a comparison is made between the pre-course and post-course survey responses it becomes more likely that the two sets of time points responses will differ on at least one subscale due to random chance.

The three attributes that each student described for the *Student Expectations Assessment* were used to generate the following categories by sorting and classifying their responses according to content analysis principles:<sup>13</sup> (1) vision; (2) communication; (3) confidence; (4) courage; (5) inspiration/motivation; (6) introspection/values; (7) trust; (8) empathy/interest; (9) judgment/decision-making; (10) diversity/intercultural understanding; (11) organizational skills; (12) respect for authority; (13) creative/entrepreneurial.

Linking Assessments. The results from the two assessments were linked by mapping the five expectations attributes students most frequently provided for the *Student Expectations*

*Assessment* to the content of the *Leadership Principles Survey* items, which were faculty-defined educational objectives. The professor of the class and an assessment specialist independently coded which of the five most frequent *Student Expectations Assessment* categories mapped on a sample of 29 *Leadership Principles Survey* items. The percentage agreement between the professor's codes and the specialist's codes for the sample items provided an estimate of the reliability, or reproducibility, of the item coding decisions. The percentage agreement between the two scorers' codes for the selected items was roughly 90%, which is judged to be an acceptable level of agreement. In most situations 80% agreement is acceptable, but since percentage agreement is a liberal index, the more stringent cutoff of 90% was used.<sup>14</sup> See Figure 2 for a graphical representation of this assessment linking.

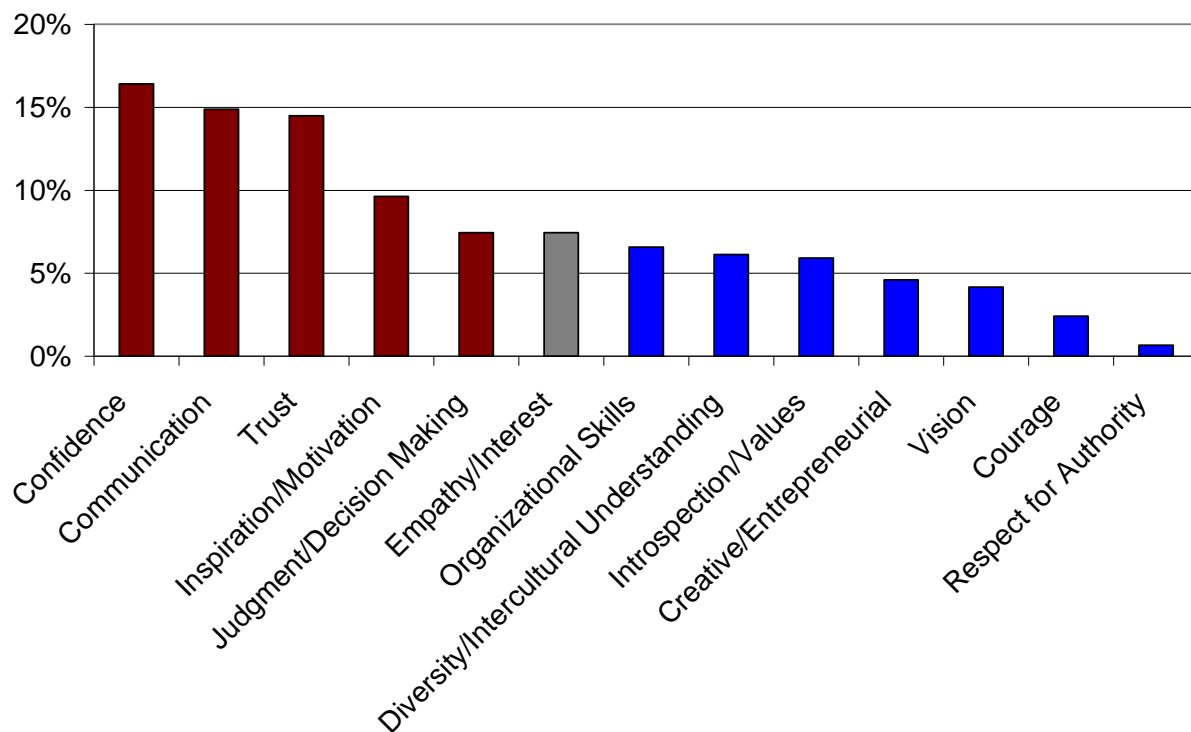
Figure 2: Process by which student expectations were compared with faculty-defined educational objectives assessment results



## Results

The hierarchy of categorized leadership learning expectations that students reported for the *Student Expectations Assessment* appear in Figure 3. The five most frequently listed student-reported expectation attributes were: (1) confidence (16.4%,  $N = 75$ ), (2) communication ability (14.9%,  $N = 68$ ), (3) trust in team members (14.5%,  $N = 63$ ), (4) ability to inspire/motivate (9.6%,  $N = 44$ ), (5) ability to exercise sound judgment or make decisions (7.4%,  $N = 34$ ). While empathy/interest (7.4%,  $N = 34$ ) was listed as often as judgment/decision making, the ability to exercise sound judgment was selected as one of the top five student expectations instead of the construct empathy because of the ability to directly correlate this expectation with the assessment instrument (i.e., the instrument contained explicit judgment-related questions but did not contain any empathy-specific questions).

Figure 3: Hierarchy of student leadership learning expectations



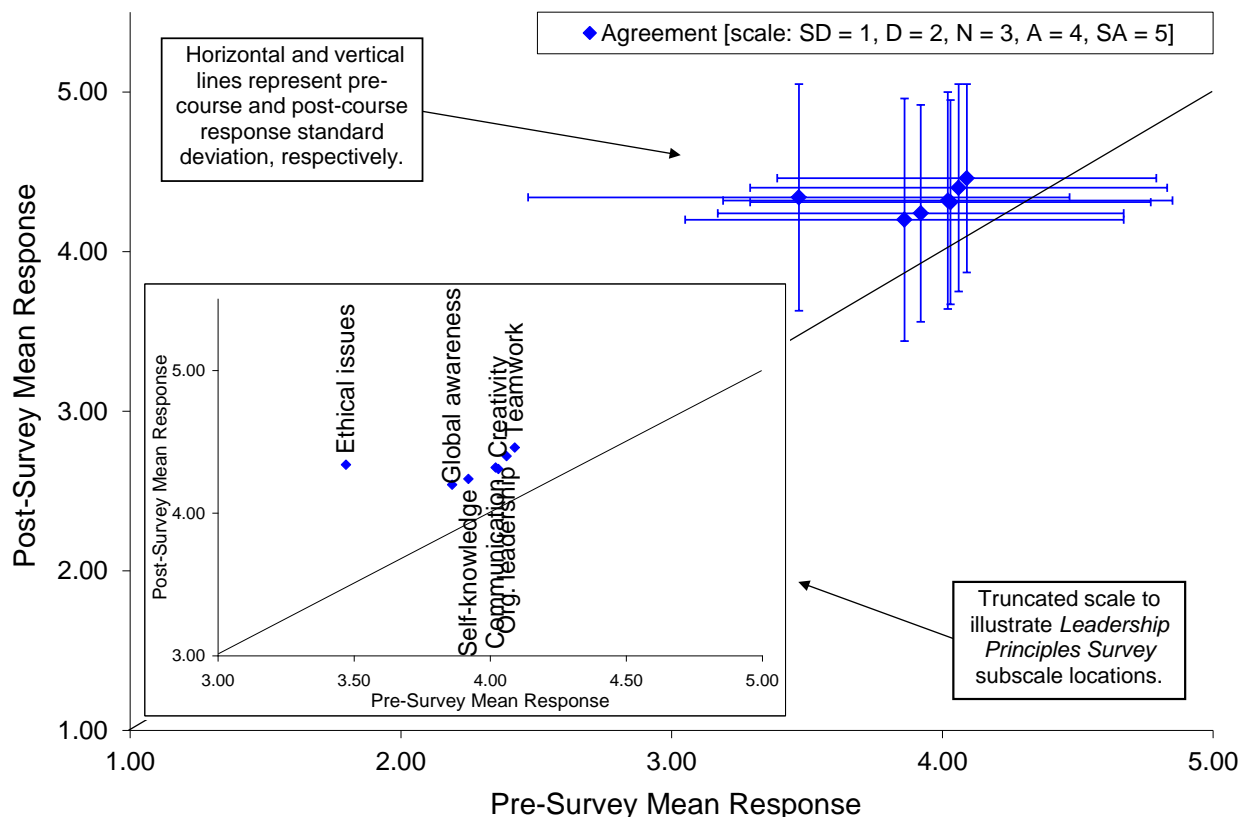
The mean response for each *Leadership Principles Survey* subscale increased or moved towards the *agree* side of the scale from the pre-course to the post-course survey, which is in the desired and anticipated direction. Figure 4 depicts the mean response shift for each of the seven subscale over the two time points as well as where the mean response for each subscale is located in the graphical space with respect to each other. Refer to the inset truncated scale for subscale labels. The degree to which each *Leadership Principles Survey* subscale mean response increased from pre-course to post-course is represented by the 45° line such that points above the line represent a shift towards the *agree* (scale = 4) and *strongly agree* (scale = 5) side of the scale. As such, the largest pre-course to post-course survey subscale mean response shift occurred for the subscale ethical issues as it is farthest from the 45° line. The mean response shift was similar between the



two time points for the other six subscales (global awareness, world view; oral communication skills; organizational/leadership skills; self-knowledge; creativity; teamwork).

The vertical and horizontal lines bisecting each subscale point signify the standard deviation, which is the variation or dispersion from the mean, for each of the seven subscales. The standard deviation for the pre-survey mean response (horizontal lines) is larger than for the standard deviation for the post-survey mean response (vertical lines) for each of the seven subscales, which signifies that there was less variation or spread from the mean in the students' post-survey responses when compared to their pre-survey responses. This finding is evidence that the students' survey responses were more similar after taking the leadership class, which provides indication that the students' perceptions of their leadership competencies became more consistent with their classmates' responses by the end of the class.

Figure 4: Item mean comparison of *Leadership Principles Survey* seven subscales



Paired-samples *t*-tests were performed for each *Leadership Principles Survey* subscale to compare the matched pre-course survey and post-course survey student responses. All subscales yielded significant results, which held at the family-wise significance level ( $\alpha = .007$ ). Specifically, there was a significant time point effect for all subscales as the post-course survey mean responses were significantly higher on the 5-point scale than the pre-course survey mean responses. See Table 2 for all subscale results. This indicates that not only was there an increase in the student response means from the pre-course survey to the post-course survey, but there is evidence that this time point shift was not likely due to only random chance.

Table 2: Descriptive statistics and paired-samples *t*-test results for *Leadership Principles Survey* subscale responses.

<b>Subscale</b> <i>Degrees of freedom = 78</i>	<b>Time Point</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b><i>t</i>-statistic</b>
Understanding of ethical issues	Pre-course	3.47	1.00	9.96*
	Post-course	4.34	0.71	
Teamwork	Pre-course	4.09	0.70	8.89*
	Post-course	4.46	0.59	
Global awareness, worldview	Pre-course	3.86	0.81	8.02*
	Post-course	4.20	0.76	
Organization/leadership skills	Pre-course	4.06	0.77	5.61*
	Post-course	4.40	0.65	
Self-knowledge	Pre-course	3.92	0.75	7.99*
	Post-course	4.24	0.68	
Communication skills	Pre-course	4.02	0.83	5.57*
	Post-course	4.32	0.68	
Creativity	Pre-course	4.03	0.74	4.37*
	Post-course	4.31	0.64	

*Note.* Subscales are in descending order of largest to smallest increase in the pre-course to post-course subscale mean response.

\**p* value <.0001, which is significant at the family-wise significance level ( $\alpha = .007$ ).

The student pre-course and post-course item mean responses to the *Leadership Principles Survey* were mapped onto the five most frequently student-identified learning expectation objectives. These results appear in Figures 5 - 9 with sample item content. The sample item content is provided in order to give examples of item types as well as make available the content of the items that had the greatest pre-course to post-course mean response shift. Mean response shift is represented by distance above the 45° line. For example, in Figure 5 the mean response from pre-course to post-course increased the most for Item 3. The student item mean responses from pre-course to post-course survey moved from the *disagree* to *agree* end of the scale for all five student-identified learning objectives, which was the anticipated direction of response if the class positively changed students' leadership self-perceptions.

Across the seven subscales, the student item mean response shifted the most from pre-course to post-course for Items 3 and 4 (See Figure 5). Upon further investigation, it was noted that these two items were the only items in the *Leadership Principles Survey* that were related to skills (Item 3: "I can apply different ethical frameworks to analyze an ethical problem." Item 4: "I can apply a professional code of ethics to analyze an ethical problem."). Although the emphasis on skills and abilities (i.e., vs. knowledge and awareness) is less in this introductory class than it is in later more advanced classes within the minor, additional skill-based and ability-based questions have been added to the survey and will be administered in future offerings of the leadership class.

Another interesting finding was the *Leadership Principles Survey* item mean responses that mapped onto the student expectation Confidence tended to cluster together except for Item 10 - "I

feel I can do something when I hear about bad things in the world” - (See Figure 6). The content of the items that clustered tended to concern confidence with respect to working with people of different backgrounds, project management, taking leadership or initiative, and ability to work on teams. A plausible explanation is that more survey items mapped onto the student expectation Confidence than the other student expectations categories. Perhaps if more item mean responses mapped onto the other student expectations, then they would have formed a similar cluster pattern. Alternately, most (>90%) of the students taking this 2-credit Leadership Principles class also took the 1-credit companion class *Leadership Experience*. In *Leadership Experience*, students are engaged primarily in hands-on real-world projects related to change processes in developing world communities; this experience may have positively affected their self-efficacy in this category.

Figure 5: *Leadership Principles Survey* item mean comparison for items that map onto student expectation **Judgment**.

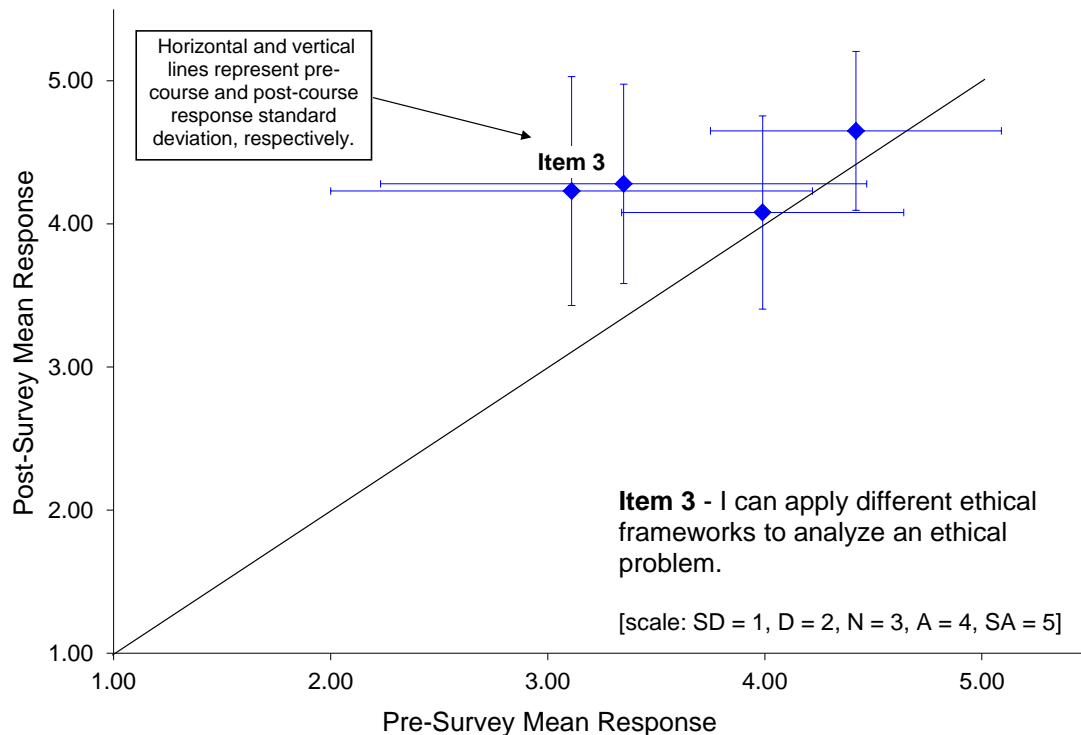


Figure 6: *Leadership Principles Survey* item mean comparison for items that map onto student expectation **Confidence**.

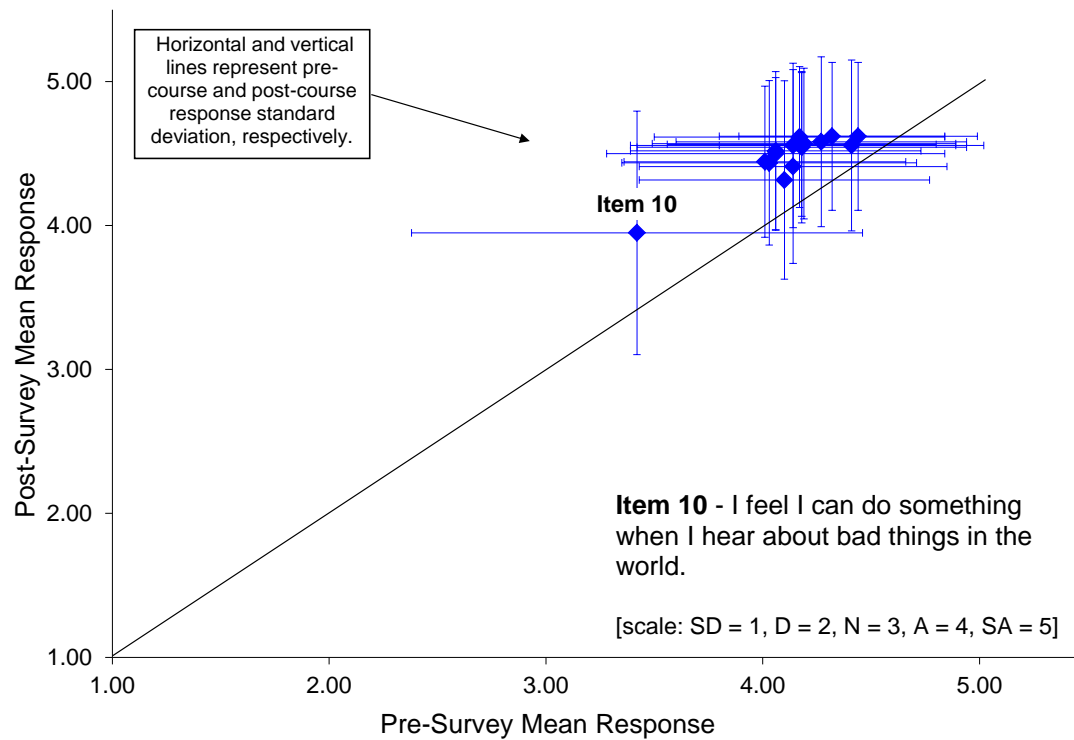


Figure 7: *Leadership Principles Survey* item mean comparison for items that map onto student expectation **Communication**.

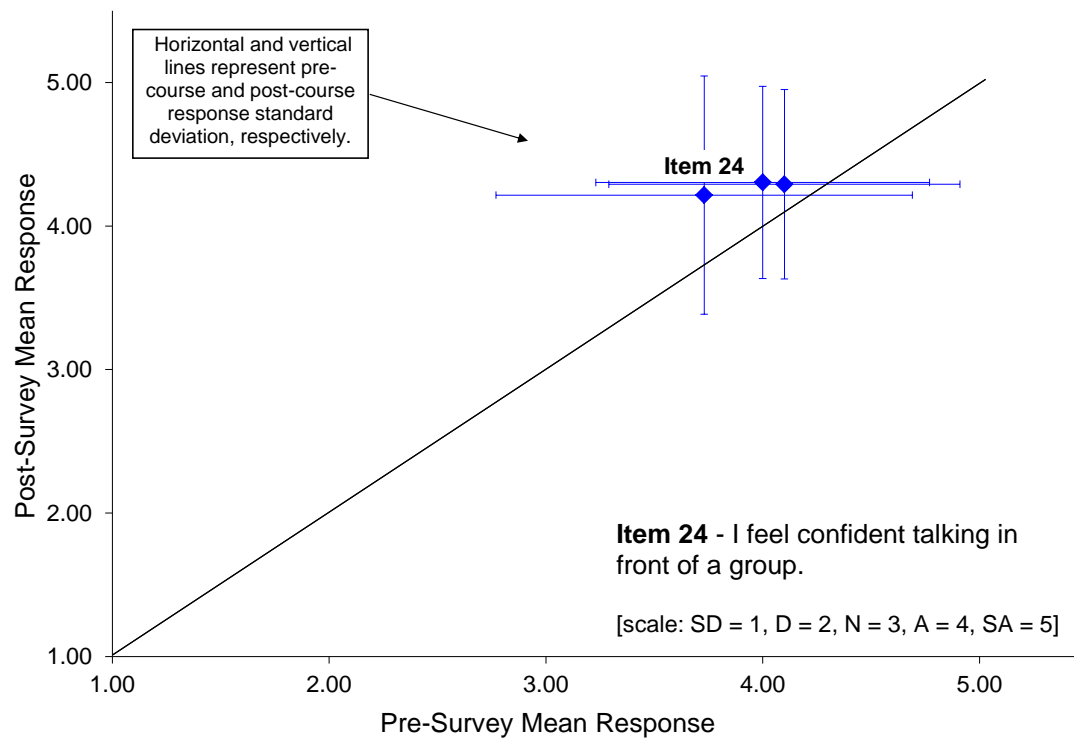


Figure 8: *Leadership Principles Survey* item mean comparison for items that map onto student expectation **Motivation**.

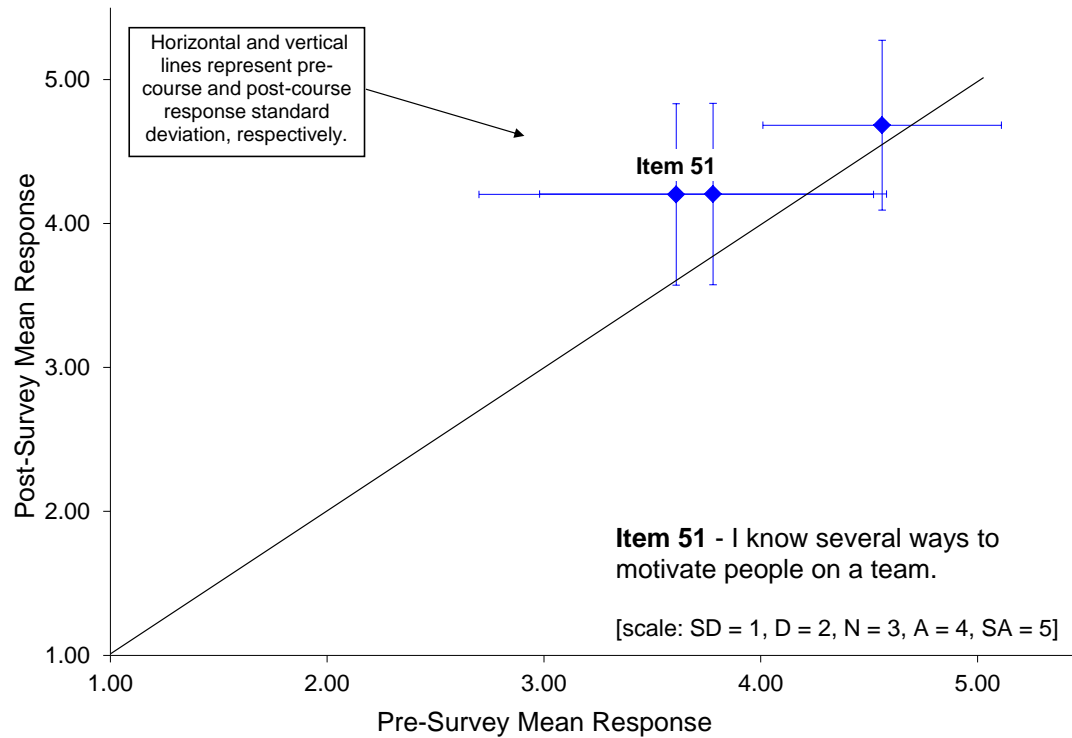
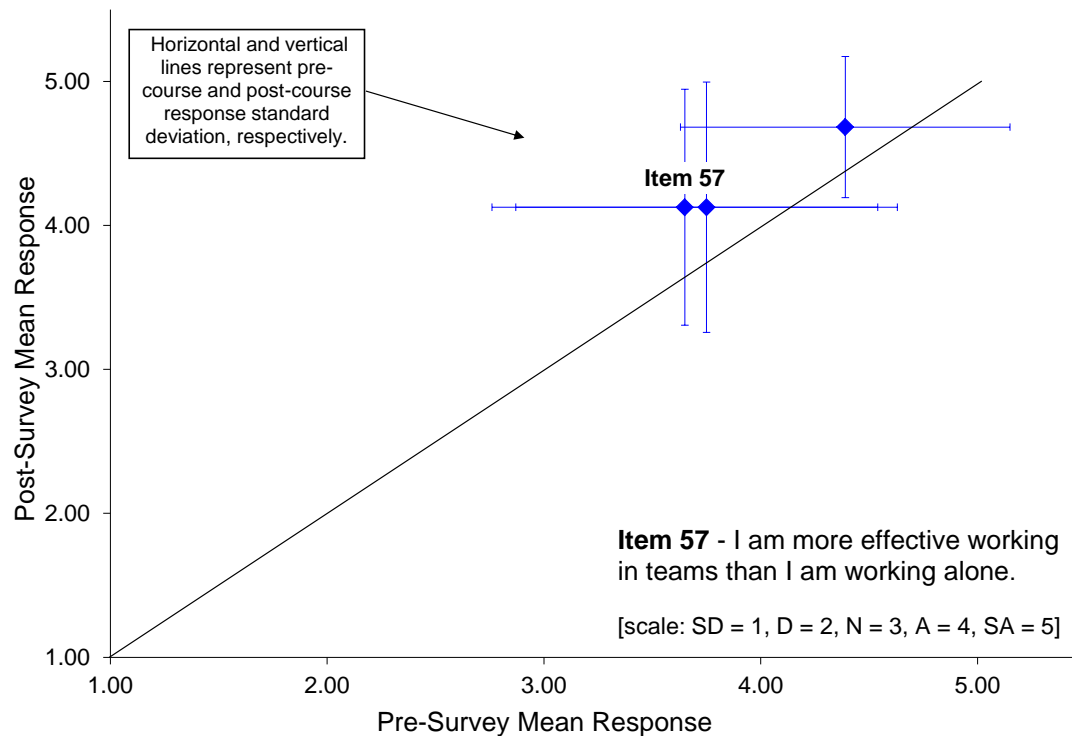


Figure 9: *Leadership Principles Survey* item mean comparison for items that map onto student expectation **Trust**.



## Discussion

Recent trends in education are towards providing students greater participation in the definition of the course learning outcomes; some faculty are even lauded for tearing up their well-crafted syllabus each semester and engaging the class in content definition.<sup>15</sup> Contrasting student-defined expectations with those of the instructor and the changes in student self-assessment offers an additional performance index for assessment and facilitates continuous quality improvement of course content. In this class, student-defined learning expectations were used as both pedagogical and assessment tools. The data were collected, shared with students, discussed, and subsequently used to help form the content. This combined approach is especially salient in a class on leadership; teaching students a common vernacular with which to speak and then allowing them a participative voice in their own learning is empowering and potentially transformative. The assessment then becomes a part of the learning experience instead of simply an exogenous metric.

As mentioned earlier in this paper, a literature review revealed a paucity of investigation into assessment linking student course expectations to instructor expectations; therefore, it is difficult to interpret the specific results of this work within the context of the current literature. Within the context of assessing student self-efficacy, various facets of this assessment instrument touched on the students' self-measure of ability to accomplish specific tasks (e.g. Judgment, Item 3, "I can apply different ethical frameworks to analyze an ethical problem.") and reach specific goals (e.g. Confidence, Item 10, "I feel I can do something when I hear about bad things in the world."). The literature for undergraduate engineering student self-efficacy in venture creation indicates the critical role played by curricular authenticity: clear value to the curricular material; meaningful performance feedback by the instructor.<sup>16</sup> There may be opportunities for leadership educators to learn from the entrepreneurship literature with respect to effective pedagogy.

Positive mean differences were achieved for all 65 core items on the survey. The three items with the least mean difference were Item 7 ("If there is an in-class topic that I am not aware of, I feel the pressure to learn that topic."), Item 31 ("I am aware of what I know and what I do not know."), and Item 43 ("I am likely to try my best in what I do."). These items were not leadership-specific and all possessed high mean responses in the pre-course survey, which may explain the low mean difference. While a positive mean difference is desired in student assessment, this outcome is not always the case. The significant positive mean differences for all seven subscales measured might be viewed as atypical; however, this is not a typical class in terms of student composition or curriculum. Students self-select to take this class (i.e., it is an elective), standard examinations are not used to assess student performance (instead a rich array of rigorous written and oral metrics is used), students are actively engaged in-class to participate in the subject material (i.e., the instructor's role is that of a framer and facilitator vs. "the sage on the stage"), and the class is accompanied by a laboratory where students actively apply and practice the material they learn in class. Anecdotally, student-written assessment comments to the instructor at the end of the semester often reflected that students felt they had worked harder per credit in the leadership principles class than in their other classes, but that this extra effort was worth it. Electively taking and working harder in a non-required class requires intrinsic motivation. Given the rich literature on the power of intrinsic motivation<sup>17, 18</sup> and its effect on

passion, interest, and even creativity in teams,<sup>19</sup> the positive assessment results of this class should perhaps be framed within this context.

In the course discussed here, significant changes were seen in areas where focus was great (i.e., global awareness and ethics). For example, global awareness was integrated implicitly into each “block” (~3 week topical focus) through assigned readings and in-class discussion; students were required to read the *Economist* magazine and be prepared each class to be called upon to give a 3-5 minute impromptu presentation relating a recent news story reported by the *Economist* to the topical material for that class. Diversity, including intercultural aspects, was also an explicit course topic (i.e., understanding others). The 1-credit leadership laboratory, which accompanies this course, was comprised almost exclusively of projects relating to or with partners in another country (mostly in the developing world), thus likely providing an additional layer of topical integration.

Because this is an introductory class, the curricular emphasis (and therefore assessment) is upon building awareness and understanding; later courses in the minor sequence focus to a greater extent on skills and abilities. The greatest program-defined outcome difference seen in pre- and post- course assessment was in the topic of ethics. Ethics was addressed implicitly throughout the course as well as explicitly (i.e., blocks on “judgment” and “moral courage”); ethics was also integrated within a group position paper crafted over a several week period analyzing the judgment process of leaders. Outcome Item 3 (“I can apply different ethical frameworks to analyze an ethical problem.”) and Item 4 (“I can apply a professional code of ethics to analyze an ethical problem.”) were the strongest drivers in the assessed change within the ethics outcome category. Furthermore, these two items, which mapped onto Judgment in the *Student Expectations Assessment* categories (Figure 5), were prime drivers in the time point shift seen for the Judgment category. These questions (i.e., Items 3 and 4) are distinct from all of the other items in the analysis in that they refer to concrete skill outcomes (i.e., application of ethical frameworks, code of ethics) as opposed to increased knowledge and awareness. This may affect the relative scoring of these two parameters and therefore must place them in perspective. Developing a curriculum to target these objectives is more straightforward than that of curriculum targeted at developing for example, “confidence.” Additionally, assessment questions targeted at skills and abilities perhaps elicited greater self-perceived changes.

## Conclusions

1. Students enrolled in the leadership principles class frequently provided responses related to *confidence*, *communication ability*, and *trust in team members* when asked what three leadership attributes they would like to develop. These attributes were developed implicitly within the course structure.
2. The students fourth and fifth ranked responses, related to attributes they would like to develop, were *inspiration/motivation* and *judgment/decision making*; both attributes were explicitly addressed within the class material.
3. Overall, the students perceived their leadership competency more positively after taking the leadership principles class than before they took the class.

4. Also, the students' survey responses tended to be more homogeneous (i.e., less varied) after taking the leadership class, which could be an indicator that the students experienced a confluence of leadership ideas as a result of taking part in the class.
5. Furthermore, the students' survey responses indicate that they gained leadership competency in each of the seven subscales and that these gains were not likely due to random chance. The greatest gains were seen in *understanding of ethical issues*, *teamwork*, and *global awareness, worldview*.
6. The greatest change in item mean response from before the students took the class to after they completed the class was related to skills. This finding warrants further investigation as there were only two skill-related items in the assessment instrument.

The method with which leadership learning is accomplished is the driver of assessment results; traditional academic delivery and reliance on extrinsic motivation are not preferred pathways. Opportunities exist for leadership educators to gain insights from learning within the academic entrepreneurship community. Given the early stage of definition of the engineering leadership domain, it is of value to obtain, assess, and include student expectations as a tool in curriculum development and evolution, even (or especially) if it leads down difficult and lightly-travelled curricular pathways.



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