Educat ing the Whole Engineer: 
Transforming an Introductory Engineering Survey Course
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Background
• Engineering education is the delivery of knowledge through the classroom experience
• The “banking” model used at the expense of developing the cognitive capacity
• “Self-authorship”: the development of an internal voice; beliefs, identities and social relationships [1]
• Groundwork of self-authorship needs to start at the freshman level[3]

Research Questions
1. Does inclusion of a discussion opportunity improve student development in (a) integrative learning and knowledge and (b) lay the groundwork for self-authorship beginnings?
2. At the end of the course, is the student more confident in declaring a major?

Formerly Engineering 110
• Delivered as a 2-day per week lecture style; in an auditorium seating over 350 students
• Little interaction between student and instructor
• Each department had a lecture session
• Included 40-minute departmental presentations
• Approximately 300 first year students enroll

Course Transformation
• A lecture/discussion style
• Launched Fall 2014, 263 students enrolled
• 15 discussions sections of 20 students or less.
• Upper level engineering students were peer facilitators
• Lecture content focused on the “grand challenges” of engineering
• Departmental presentations reduced to 15-minute timeslots, 3 per lecture session

Survey Instrument
• Developed, using a modified Self-Authorship Survey (SAS)[3] and a modified Integrative Knowledge Portfolio survey self-assessment instrument [4]
• Resulted in a 33-item survey
• Extracted 8 sub-factors

<table>
<thead>
<tr>
<th>Concept Name</th>
<th>Factors represent respondent capacity for:</th>
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<tbody>
<tr>
<td>Knowledge (K)</td>
<td>1. Knowledge gained within and across specific contexts</td>
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<td>Self-Learner (SL)</td>
<td>2. Understanding and directing oneself as a learner</td>
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<td>RAR Learner (RAR)</td>
<td>3. Becoming a reflexive, accountable, and rationale learner</td>
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<tr>
<td>Ethics &amp; Perspectives (EP)</td>
<td>4. Identifying and discerning one’s own and others’ ethics and perspectives</td>
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<td>Digital (D)</td>
<td>5. Developing a professional digital identity</td>
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<tr>
<td>Career (C)</td>
<td>6. Career specific goals, relate to career choices</td>
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<tr>
<td>Autonomous Action (AA)</td>
<td>7. Emotional and behavioral independence</td>
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<tr>
<td>Problem Solving (PS)</td>
<td>8. Need to reflect on their beliefs</td>
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Discussion Topics
1. Professional Image
2. Common Reading Experience
4. Sustainability in Student Life
5. Globalization of the Engineering Field
6. Values, Priorities and Responsibilities
7. Metacognition & Academic Resources
8. Identity - Understanding Differences and Perspectives
9. Co-Curricular Opportunities
10. Professional Responsibility and Role in Society
11. Department Exploration Day
12. My Journey (Peer Facilitators Stories)
13. Goal Setting and Educational Planning

Conclusion
• Students increased confidence in choosing a major
• Time that students spent on factors was helpful, but not significantly influential
• Clear indicator of student engagement, the final teaching evaluations students ranked the peer facilitators as
  o 4.8 out of 5.0 (average score), “The facilitator made me feel valued in the course”
  o 5.0 out of 5.0 (average score), “The facilitator was an excellent teacher”

Future Work
• Conducting Focus Groups
• Longitudinal studies
• Explore more specific learning outcomes
• Scalability of the course

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References

Survey: Control Pre vs. Control Post
Comparing gains of control vs. intervention: *p<0.001
Comparing pre-control to pre-intervention: *p<0.001
Comparing gains of control vs. intervention: #p<0.001