# Group Vision for the Future of First-Year Engineering Programs

*Led by Jim Nelson*

**Challenge.** Imagine yourself teaching first-year engineering students 15 years from now, considering the current educational, national, global, . . ., trends that you foresee as drivers. Thinking from different points of view (traditional, cyber, sci-fi, optimistic, pessimistic), what should first-year engineering education be like?

1. By yourself, write down things that come to mind on Post-It notes. (8 minutes)
2. Share the things you wrote down with the others at your table. (15 minutes)
3. One table at a time, stand up and briefly tell the entire group what you came up with. Put your smaller Post-It notes on several giant Post-It notes hung around the room, trying to keep similar ideas together. Subsequent tables please give the general gist of your discussion and emphasize differences from tables presenting earlier. (20 minutes)
4. Everybody mill around to make sure the small Post-It notes are categorized appropriately on the big Post-It notes, and add titles to each grouping - just grab a pen and add a title that you think is descriptive. One large Post-It may contain 3 or 4 smaller categories. (15 minutes)
5. Each person will be given five voting stickers. Please put your stickers on the categories that you see as having the most potential for moving forward from where we are now. (10 minutes)
6. Discuss the results. (5 minutes)

**Results.** The ideas written on the Post-It notes are provided below each category below.

Engineering Curriculum (12 votes)

- Barriers between traditional engineering disciplines continue to break down; will educate generic engineers
- Research training with publication requirement built into undergrad curriculum; this training starts freshman year
- Service learning projects
- Interdisciplinary projects
- Cover all engineering disciplines (don't leave out any disciplines)

- Math, science & G.E. curriculum directly supporting engineering curriculum
- Applies strong connections between content / curriculum across disciplines
- Interdisciplinary approach (nanotechnology is intersection of engineering, material science, chemistry, etc.)
- Applies strong connections between content / curriculum across disciplines
- Engineering becomes more segmented, with more specific disciplines, freshman experiences must become focused on each academic area (no unified freshman curriculum)
- Need to be ethical engineers
- Project management skills and knowledge
- Communication
- Project management
- Entrepreneurship
- Superior design and analytical skills
- T-shaped people: broad across many areas, deep in a few; this means engineers with business skills, people skills, etc.

Diversity / International (11 votes)

- Diversity, minority, social class adaptation, receptive
- Understanding of different cultures and engineering problems facing different groups
- Collaboration with students in foreign countries (global engineering)
- International exposure
- Working in multilingual and multicultural environments
- International communication standard for design & specification
- Projects cover areas of interest to male & female population

Otherwise Prepared Students / Remediation (10 votes)

- Engaging for all Math prep levels
- Address needs of “late starters”
- Address needs of “unnecessarily discouraged”
- Minority / disadvantaged students: improve plan for extra initial quarter or semester for students who need it

Faculty Training (9 votes)

- Uses and invests in strong first year instructors
- Allow next generation of profs to “shuffle the deck” and make their own radical changes
- Orient to process, allow tools & contexts to change to remain relevant
- Process & content are relevant & flexible
- Disseminate results as you change & adapt program
- Broader impact / public relations

Global / Environmental Science (9 votes)

- Environmental focus
- Global viewpoint
- Incorporates service to society “messaging”
- Look at sustainability and sustainability engineering
- Has a flexible lens: prepares them to address universal / global problems and local / personal issues
- Design projects that incorporate “real-world” current and future problems

Technologies Impacting Education (9 votes)

- Working with virtual worlds, instrumentation, global teams
- Bring hand held computer to class – no computer labs, no laptops
- Virtual labs
- Ubiquitous information access: every test will be open book, open internet, etc.
- RFID homework
- Manage information overload: teach students how to be effective engineers in a world of abundant distractions and information half-life
- No textbooks: electronic alternatives such as internet, hand-held displays, computer e-books, etc.
- Virtual classrooms in second life with experiments constructed of virtual solids backed by software

Educational Options (7 votes)

- Students build their own curriculum with peers
- Year round school concept: four 10-week items with no summer school
- Individualized degree programs
- Self-defined curriculum (more flexibility in defining educational goals / outcomes)
- Engineering taught as a holistic field; less discipline specific
- Engineering as a professional degree; specialize as a M.S.
- Engineering competence determined by passing an FE type test; no formal degrees will be required
- Hybrid: 1 day per month in class, streaming all other classes
- All 3-year B.S. programs based on current 5-year M.S. programs

K-12 (6 votes)

- AP engineering courses offered to high school students
- Increased collaboration with high school and community colleges
- Increasing number of unprepared students

Influence of Classroom Tone: Confidence, Creativity, Desire (6 votes)

- Instill confidence in independent problem formulation (they recognize problems)
- Promote desire in engineering
- Highlights and incorporates engineer's need for creativity
- Confidence to pursue engineering building

Problems of the Future (6 votes)

- Emphasis on design for the billions in the developing world
- Loss of biodiversity
- Post peak oil energy policy
- Cyber infrastructure
- Affordable space travel (i.e., space elevator)
- Focus on energy independence, move away from foreign oil
- Identify next emerging problems / technologies to impact
- Health care in a post-cancer world
- Program changes with the times, technology and world issues
- Growing global poverty

Integrating New Technologies (4 votes)

- How to integrate breakthroughs in science into technological solutions
- Desktop personal DNA sequencing

Continued Interaction with People (4 votes)

- Keep hands-on component prevalent
- Freshman activities and skills are used and expanded upon in subsequent classes (sophomore to senior)
- Retain the human element
- Fosters strong peer-mentoring interaction

Faculty Support (3 votes)

- Support small (single professor) innovations as well as larger scale innovations

Define Engineering (1 vote)

- Environmental / economic assessment of design & manufacture
- How to work in teams with dynamic composition, multidisciplinary teams that reorganize as opportunities / threats emerge and projects mature
- We have a fairly common definition of engineering and convey it to the entering students

Assessment (1 vote)

- Adaptive assessment instruments

Adaptive (1 vote)

- Sliding scale of student experiences: customized, inspiring, innovative, diverse
- Give students a wide range of experiences: hands-on to conceptual, individual to group, structured to open-ended

Pedagogy (0 votes)

- Understand team interactions at a research level
- Emphasis on hands-on learning
- Application & theory - - theory & application (the line between these is no longer obvious)
- Empower students to maximize their learning through non-traditional methods
- Promote student-based problem recognition, “vigilance” from team
- Using the Randy Pausch “head fake”

Non-engineering Education (0 votes)

- Teach literacy for non-technical students

24/7 Support Structure (0 votes)

- 24/7 access to content, etc.
- 24-hr help desk