



Why Producing Engineers is Challenging

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Today's Talk

- Status
- What we know
- Issues
- What is being done
- What should be done

Status - Education performance of 4th grade 8th grade and 15 year olds

- Among 34 OECD countries (Organization for Economic Co-operation and Development)
 - PISA results 2012 (Program for International Student Assessment)- Math, Reading and Science
 - USA ranked 17th of 34 countries in reading, 21st in science, 26th in math, which doesn't look good. Did not improve since 2006
 - "A picture of educational stagnation" "An absolute wake-up call for America," – Arne Duncan – U.S. Education Secretary
 - Source: OCED.org, The Economist Dec 7th 2013, Page 62
 - Capital in the 21st century - Thomas Piketty — the French economist
 - This is the first-ever comprehensive survey of the skills in literacy, numeracy and technology.
 - In numeracy and technological proficiency, young Americans who are on the cusp of entering the workforce — ages 16 to 24 — rank last.
 - Source: America's educational failings – F. Zakaria, Wash Post May 1st 2014
 - Silver lining- As per PISA, American students perform above average in problem-solving, creativity, novelty, and critical thinking.



What we know

On a relative scale: From the previous references

- “The biggest force behind falling American rankings is not that the United States is doing things much worse but that other countries have caught up and are doing better.”
- “The U.S. system of education and training is inadequate in the new global environment.”

- - F. Zakaria, Wash Post May 1st 2014

- PISA test shows that

- American students perform above average in problem-solving, creativity, novelty, and critical thinking.
- Poor in math, reading, and science

- On an absolute scale: We are very good in setting standards and generating ideas but poor with implementation

- Lack of sufficient depth, budget, quality, and rigor
- Countries that do better than USA balance breadth and depth in STEM education. US K-12 ed is more breadth than depth.
 - We must balance teaching of fundamental concepts and problem solving skill development




Issues

■ Several research articles out of College of Education, news reports, including my own research supported my NSF point to these factors

- K 12 Education – Science neglected for many years
 - Quality of Teacher – particularly elementary school
 - Not prepared to teach different subjects if the same instructor is teaching all subjects
 - Low pay does not attract the well qualified
 - Technology alone will not solve the problem but will make them more effective
 - STEM Engagement time at school is less than many OECD countries-particularly in science
 - Lacks rigor in implementation
 - Science was not tested until recently
 - Hands on learning is fun but the real issue is that the science behind the experiment is not often discussed (*know vs know how*)
 - Lack of teacher content-knowledge
 - Lack of time (disciplinary/student behavioral issues at some schools)

Issues (*continued*)

K 12 – University Education

- Problem solving approach to learning is not emphasized enough
- Individual subjects are still being taught like silos without much attention to their integration for problem solving
- Education policies
 - Where should fed and state spend their money?
 - Do we have the loop complete? industry needs  education design
 - More important – how often is the above loop visited?
 - Common Core – yes or no? No science in common core. States are in the process of adopting Next Gen science standards.
 - More important – how to implement for different factions of the student population with problem solving skills as a focus?
 - Assessment and rewarding mechanism
- Distractions – ever increasing
 - Are parents doing enough to moderate the time spent on distractions?
 - How involved are we in our children's education?



What is being done

- Change the Equation (CTEq) pins its hopes on
 - Common Core and its equivalent and the Next Gen Science Standards
- In Virginia – VISTA (Virginia Initiative for Science Teaching and Achievement) innovates science education in Virginia and beyond by promoting hands-on, problem based learning
- Industry/Govt Agencies have increasingly shown more involvement in K-12 Education
 - Fund-raising for scholarships
 - Volunteering in classrooms, science fairs
- Online Delivery of STEM, Ex: Khan Academy, MOOCs, teachengineering.org

What should be done (several stakeholders)

- Math, English Language Arts, Science, and **Coding**
 - We know what should be taught – **the question is how to implement it**
 - Emphasize problem-based learning – skill development through K-16
 - Discuss fundamental science behind hands-on activity
 - More engagement **time** with STEM subjects in schools, **rigor** in implementation
 - Start early – early childhood and elementary school education
 - Resources
 - Data: Connection between industry/govt needs and education design must be often visited
 - **\$\$\$**: Intensive teacher training on content-knowledge and on the use of problem-based learning (style of instruction), recruit **qualified** teachers with higher pay
 - Parents - Know the facts and get involved, onus cannot be only on teachers, question and participate in the implementation phase
 - More university- and industry/govt-school division partnerships
 - Several moving parts- need a systems thinking approach with **particular attention to implementation in the coming years**
 - Aligning instruction, curriculum, standards and assessment.