

**Session #: S8-CT7**

Special Session

## Have We Met the Vision of Engineering 2020 and What is Our Vision for 2040?

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# Agenda 2:15pm (New York) 20:15 (Uppsala) 3:15pm (Sydney)

**2:15pm:** Welcome, session structure (Senay)

Previous FIE panels on new frontiers (Karl)

Recommendations & trends from back then

**2:30pm:** Waves of generations: Session goal & Breakout sessions (Senay)

**3:00pm:** Synthesis, reactions, and whole group discussion

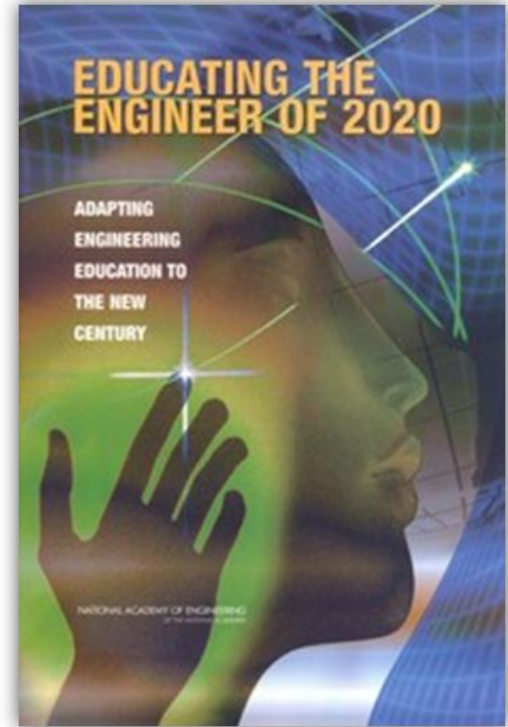
**3:30pm:** Future steps, conclusions and session evaluation

# Previous FIE Panels

- The Future of Engineering Education. FIE 2002. Session T4A.
  - Larry J. Shuman, Elizabeth A. Eschenbach, Don Evans, Richard M. Felder, P. K. Imbrie, Jack McGourty, Ronald L. Miller, Larry G. Richards, Karl A. Smith, Eric P. Soulsby, Alisha A. Waller and Charles F. Yokomoto
- Reviewing the Past, Predicting the Future. FIE 2017. Session S2C.
  - Cynthia J. Atman, Elizabeth A. Eschenbach, Cynthia Finelli, P. K. Imbrie, Susan Lord, Ann McKenna, Larry G. Richards, Larry J. Shuman, Karl A. Smith
  - Smith presentation – Looking Back/Looking Forward – Insights from the Past; Hope for the Future [Smith-FIE2017-future-v2.pdf]
- Building on the Past, Creating the Future: Where are the New Frontiers. FIE 2018. Session T1B.
  - Larry G. Richards, Larry J. Shuman, Karl A. Smith
  - Smith presentation - Looking Back/Looking Forward - Insights from the Past; Hope for the Future [Smith-FIE\_Panel-2018-v1.pdf]

# 14 recommendations (NAE, 2005)

- Funding efforts to gather data on **diversity** and workforce (14)
- **Graduate Education:** Pre-engineering degrees and professional master's degrees (1,2,11)
- Innovations in **undergraduate education** emphasizing design, life-long learning, case studies (3,4,7,8,9,10)
- **Faculty** promotion based on engineering education research, professional development, and qualifications (5,6)
- Supporting **K-12** math, science, and engineering education and promoting public understanding of engineering (12, 13)



# Please share in the “chat”

What books, reports, etc. impacted your path to/in engineering education?

# Waves of Engineering Educators



- **1<sup>st</sup> wave** - Frontiers who authored/impacted the early reports.
- **2<sup>nd</sup> wave** - Those who were tenured/on the path to tenure in 2005 based on research in engineering education.
- **3<sup>rd</sup> wave** - Those who were doing engineering education research as graduate or undergraduate students in 2005.
- **4<sup>th</sup> wave** - Those who were high school or college students in 2005.
- **5<sup>th</sup> wave** - Those who were K-8 (elementary & middle) students in 2005.

Which wave are you? Please go to [www.menti.com](http://www.menti.com) and enter the code **30 46 26 4**

# A 3rd wave perspective





- What is the future direction for the engineering education sector?
  - The **first anticipated trend** is a tilting of the global axis of engineering education leadership.
  - The **second anticipated trend** is a move towards socially-relevant and outward-facing engineering curricula.
  - The **third anticipated trend** for the sector is therefore the emergence of a new generation of leaders in engineering education that delivers integrated student-centered curricula at scale.

“This is the future of the field, where you put the student at the center and use the resources to facilitate team projects and authentic experiences, and then put the taught curriculum online.”



# Things we did not have in 2000

2003 Skype

2004 Bluetooth

2005 Youtube, city-wide wi-fi

2006 Facebook and Twitter

2007 Iphone

...

2013 Zoom

# Today's plan is to recall, describe, imagine

- Let's **recall the past**. What was life like in 2005? What was education like in 2005?
- Let's **describe today**. What is life like in 2020? What is education like in 2020?
- Let's **imagine possible futures**. What do we want life to be like in 2040? What do we want education to be like in 2040?

# Prediction is difficult

*“It’s hard to predict, especially the future.”*

Niels Bohr

*“Prediction is difficult, especially about the future.”*

Yogi Berra

# Prediction is possible

*“The best way to predict the future is to invent it.”*

Alan Kay

*“The best way to predict your future is to create it.”*

Abraham Lincoln

# Agile planning

Plan A (if 15 or more participants, use breakout rooms)

Plan B (if fewer than 10 participants, stay in main room)

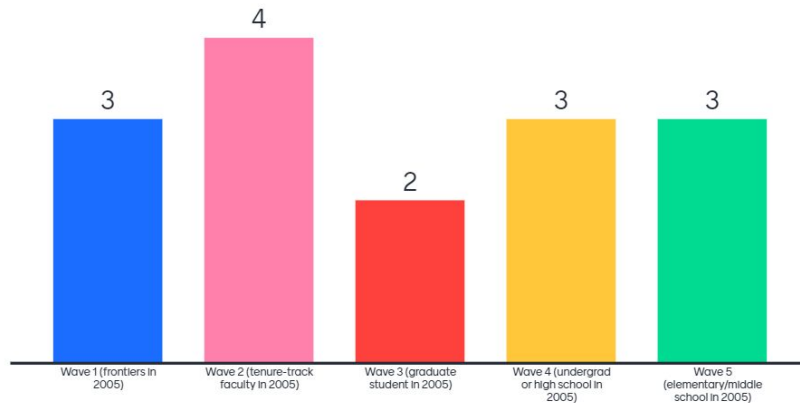
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# Multiple Choice



# Breakout Rooms

CT7-Room 1: <https://app.hopin.to/events/fie2020/sessions/7560afbc-f156-49b7-a346-114baee5758e>

CT7-Room 5: <https://app.hopin.to/events/fie2020/sessions/f8f138e2-b543-426e-9985-d181e0f986be>

# 1st WAVE & 2nd WAVE

<b>What was education like in 2005? What were the essential tools/methods?</b>	<b>What is education like today? What are the essential tools/methods?</b>	<b>What is education likely to be in 2040? What will be the essential tools/methods?</b>
<ul style="list-style-type: none"> <li>● Overhead projectors</li> <li>● Power Point</li> <li>● Reliance on textbooks</li> <li>● More “Sage on the stage” style teaching</li> <li>● Instructor-created course websites, vs LMS</li> <li>● Traditional classrooms with fixed desks, vs movable chairs/tables</li> <li>● Email and office hours for instructor-student interaction</li> <li>● Students share information locally from courses</li> <li>● Communication via e-mail</li> </ul>	<ul style="list-style-type: none"> <li>● Black/whiteboards</li> <li>● Zoom</li> <li>● Active learning</li> <li>● LMS</li> <li>● Movable chairs/tables in some classrooms</li> <li>● Email, discussion boards, other online messaging systems for instructor-student interaction, less via office hours</li> <li>● Students share information electronically from courses far and wide</li> <li>● Communication using several different channels and media</li> <li>● Online subject matter resources available for instructors and students to use</li> </ul>	<ul style="list-style-type: none"> <li>● Project-based (challenges)</li> <li>● Studios?</li> <li>● More student-centered, guide on the side emphasis</li> <li>● Hybrid</li> <li>● Reduction in the distance gap between teaching medium and the application medium</li> <li>● Modular subject matter resources</li> <li>● More emphasis on self directed learning</li> <li>● More automated methods of collecting and analyzing student feedback</li> <li>● Students design their own learning environment</li> <li>● More alliances, e.g., European University, corporate bodies?</li> <li>● Use of VR and AR for learning</li> <li>● Use of AI to identify gaps in teaching and learning</li> <li>● Just in time, on demand</li> </ul>
<p>This slide is authored by: Elizabeth Keller, Gerald Gannod, Diane Rover, Karl Smith</p>		



## 3rd WAVE

<b>What was education like in 2005? What were the essential tools/methods?</b>	<b>What is education like today? What are the essential tools/methods?</b>	<b>What is education likely to be in 2040? What will be the essential tools/methods?</b>
<ul style="list-style-type: none"><li>● Traditional but new methods emerging</li><li>● “Constructivist” approaches were new</li><li>● ...textbook dependent</li><li>● ..</li></ul>	<ul style="list-style-type: none"><li>● Mix of hands-on and traditional</li><li>● More undergrad involvement in research</li></ul>	<ul style="list-style-type: none"><li>● More project and problem-based,</li><li>● More students autonomy</li><li>● More kits as opposed to textbooks</li><li>● Mix of virtual and in-person class sessions</li></ul>

This slide is authored by: ADD

## 4th WAVE

What was education like in 2005? What were the essential tools/methods?	What is education like today? What are the essential tools/methods?	What is education likely to be in 2040? What will be the essential tools/methods?
<ul style="list-style-type: none"><li>• Computers are definitely present, as are cellular phones, but lots of students don't have their own laptops or smart phones.</li><li>• Students in college get assignments through learning management systems now, where most work was assigned in person and in class only during high school.</li><li>• Textbooks still form the major structure of teaching, but in college professors present a lot more information on slides than they did in high school.</li></ul> <p>This slide is authored by: Jacob Bishop</p>	<ul style="list-style-type: none"><li>• Use of learning management systems has increased and pretty much fully penetrated the market.</li><li>• Some courses still require textbooks, but most information can be obtained from slides or from online information...plenty of students obtain "digital" copies of textbooks of varying degrees of legitimacy.</li><li>• "Help" websites such as chegg.com are very prevalent, taking what was once part of a fraternity perk (access to past exams, homework questions and answers, etc.) into the mainstream.</li><li>• Some use of videos/youtube in the classroom.</li><li>• Most students will take at least one course completely online while in college.</li></ul>	<ul style="list-style-type: none"><li>• Most course lectures will be available completely online.</li><li>• Homework will be submitted through online systems, and will no longer be graded by hand by faculty or TAs.</li><li>• University space will still be used to complete laboratory exercises/classes. These offerings may increase.</li><li>• Some universities will no longer be viable, and will shut down. There may be some increased collaboration with technical colleges.</li><li>• Increasing numbers of students will get their education completely online.</li></ul>

## 5th WAVE

<b>What was education like in 2005? What were the essential tools/methods?</b>	<b>What is education like today? What are the essential tools/methods?</b>	<b>What is education likely to be in 2040? What will be the essential tools/methods?</b>
<ul style="list-style-type: none"><li>• Starting to standardize(?) - e.g. Everyday Mathematics</li><li>• Standardized testing</li><li>• </li></ul>	<ul style="list-style-type: none"><li>• Internet</li><li>• Access to devices</li></ul>	<ul style="list-style-type: none"><li>• Increased dependence on technology</li><li>• Increased flexibility</li><li>• More on demand content</li></ul>

This slide is authored by: ADD

# Trends, Surprises, Take-aways

- Trends towards self-directed learning, life-long learning
- Non-linear paths into careers
- Better industry ties.
- What motivates us (autonomy, mastery, purpose) [Drive by Daniel Pink]
- Purpose change from 'getting a job' to 'learning with purpose' (on demand learning?)
- Influenced by mentors/advisors about historical books/reports/... with a purpose of learning from mistakes, on the shoulder of giants.
- Looking back on earlier methods, what worked well,
- cooperative/collaborative learning
- Creative destruction?
- How institutions are to add value to society

# Contributors to this session (name, institution, email, wave)

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3. Diane Rover, Iowa State
4. Elizabeth Keller, KTH Royal Institute of Technology, Stockholm
5. Jacob Bishop
6. Athena Lin
7. Jessica Swenson

AT&T clip from 1995: <https://www.youtube.com/watch?v=a2EgfkC1eo>

# Contributors to this session (name, institution, email, wave)

1. Karl Smith, Univ of Minnesota/Purdue University, [ksmith@umn.edu](mailto:ksmith@umn.edu) (1st wave)
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7. .

# Conclusions

“It could well be that faculty members of the twenty-first century college or university will find it necessary to **set aside their roles as teachers** and instead become **designers** of learning experiences, processes, and environments.”

James Duderstadt, 1999

Nuclear Engineering Professor; Former Dean, Provost and President of the University of Michigan



"We never educate directly, but indirectly by means of the environment. Whether we permit chance environments to do the work, or whether **we design environments for the purpose** makes a great difference."

John Dewey, 1906



# Valued part of university mission

*Colleges and universities should endorse research in engineering education as a valued and rewarded activity for engineering faculty and should develop new standards for faculty qualifications.*

*Educating the Engineer of 2020 (2005)*

# Please Help Evaluate This Session

All special sessions, workshops, and panels at FIE are evaluated by participants. These evaluations are used by the planning committee to award outstanding sessions and are also used in continuous improvement from year to year.

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**Link to the survey:** <https://webropol.com/s/special-sessions-feedback>