Nurturing a Culture of Innovation & Entrepreneurship
Windhoek, 18 April 2018
Robot Doctors Replacing Real Doctors

Physician's assistant Jeffrey E. Piscitelli is accompanied on rounds by Dr. Louis Kaye, who joins him by way of video conference on a robot "Doctor" at Johns Hopkins Hospital in Baltimore.
The future of tertiary education?
Social and economic progress is achieved principally through the advancement and application of knowledge.
Is NUST ready?
Outline

• Knowledge for Innovation

• Innovation in Teaching and Learning
Imagine …

• A poor country without natural resources

• With a 5% tertiary education enrolment rate at the time of independence

• Where would this country be today if it had focused only on basic education and not built top universities?
Which country fits this description?

Brazil?

South Korea?
Explaining the difference between poverty and wealth

Real GDP per capita (2000 US$)

South Korea

Difference in output due to TFP growth or knowledge accumulation in Korea

Brazil

Difference in output due to growth in labor and capital in Korea

© K4D program
Scientists active in R&D

- **Brazil**
  - Firms: Low
  - Research Institutes: Low
  - Universities: High

- **South Korea**
  - Firms: High
  - Research Institutes: Moderate
  - Universities: High
Patents/USPTO, 1985–2012

South Korea
population: 50 millions

Brazil
population: 200 millions
Exception
INSTITUTO TECNOLÓGICO DE AERONÁUTICA
Tertiary education at the heart of economic growth

- Nordic countries
- Lisbon agenda of the EU
- Asian tigers / dragons
Singapore in 2016
Frugal innovations
Isobar
• **Diagnosis of typhus**

• **Instead of 5 days with electricity and cold chain, 55 minutes**

• **New equation for universities:** number of lives saved instead of dollars earned
Tertiary Education & the SDGs

- Preparation of skilled professionals
- Knowledge generation, adaptation & diffusion
- Institutional development & capacity building
- Values & citizenship skills
<table>
<thead>
<tr>
<th>SDGs</th>
<th>Preparation of Skilled Professionals</th>
<th>Knowledge Generation, Adaptation &amp; Diffusion</th>
<th>Institutional Development &amp; Capacity Building</th>
<th>Values &amp; Citizenship Skills</th>
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</thead>
<tbody>
<tr>
<td>1. Poverty Ended</td>
<td>X</td>
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<td>2. Sustainable Agriculture to End Hunger</td>
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<td>3. Healthy Lives</td>
<td>X</td>
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<td>4. Inclusive &amp; Equitable Quality Education</td>
<td>X</td>
<td>X</td>
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<td>5. Achieve Gender Equality</td>
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<td>6. Water &amp; Sanitation for All</td>
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<td>7. Sustainable Energy</td>
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<td>8. Inclusive &amp; Sustainable Economic Growth</td>
<td>X</td>
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<td>9. Resilient Infrastructure</td>
<td>X</td>
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<td>10. Reduced Inequality</td>
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<td>11. Sustainable Cities</td>
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<td>12. Sustainable Consumption &amp; Production</td>
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<td>13. Managed Climate Change</td>
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<td>14. Sustainable Marine Resources</td>
<td>X</td>
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<td>15. Sustainable Use of Terrestrial Systems</td>
<td>X</td>
<td>X</td>
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<td>16. Peaceful &amp; Inclusive Societies</td>
<td>X</td>
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<td>17. Global Partnership for Sustainable Development</td>
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• Knowledge for Innovation

• Innovation in Teaching and Learning
Three dimensions of innovation

• New competencies, skills, attitudes and behaviors
• New pedagogical practices
• Innovative use of new technologies
The future of jobs
(labor markets in the digital era)
The future of jobs

- Jobs that disappear (700 professions)
- New jobs
Jobs that did not exist 10 years ago

- App developer
- Social media manager / YouTube content creator
- Digital risk manager
- Smart city / smart building architect
- Driver-less car engineer
- Cloud computing specialist
- Big data analyst
- Sustainability manager
- Drone operator
The future of jobs

- Jobs that disappear (700 professions)
- New jobs
- Jobs that are undergoing transformation (47%)
Generic complex competencies

- Information analysis, critical thinking & problem solving
- Global contextual analysis
- Teamwork / collaboration
- Communication
- Creativity
“Although humans make sounds with their mouths and occasionally look at each other, there is no solid evidence that they actually communicate among themselves.”
Giorgio Armani-Samsung
Creativity is the process of generating original ideas and insights that have value.

Sir Ken Robinson
Creativity

“I didn’t know you could do that!”
Character qualities

- Curiosity (motivation)
- Initiative (entrepreneurial thinking)
- Persistence / grit
- Adaptability
- Leadership
- Ethical awareness & reasoning (social, cultural & environmental dimensions)
Meet my son Karim...
Meet my grandson Emilio...
Educational Neuroscience

Psychology
Study of mental processes responsible for cognition and behavior

Pedagogy
Study of art and science of teaching

Neuroscience
Study of the brain’s development, structure, and function

Educational Neuroscience
3 Year Old Children

Normal

Extreme Neglect
### Growth Mindset vs. Fixed Mindset

<table>
<thead>
<tr>
<th>Fixed Mindset</th>
<th>Growth Mindset</th>
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<tbody>
<tr>
<td>Intelligence is static</td>
<td>Intelligence can be developed</td>
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<tr>
<td>Avoids challenges</td>
<td>Embraces challenges</td>
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<tr>
<td>Gives up easily when facing obstacles</td>
<td>Persists despite obstacles</td>
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<tr>
<td>Sees efforts as fruitless</td>
<td>Sees efforts as path to mastery</td>
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<tr>
<td>Ignores useful feedback</td>
<td>Learns from criticism</td>
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<td>Threatened by others’ success</td>
<td>Inspired by others’ success</td>
</tr>
</tbody>
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Curricular innovations

- Experiential learning (coop, service, simulations, role playing)
- Multi-disciplinary programs
  - Amsterdam University College
  - U of Queensland School of Chemistry and Molecular Biosciences
- Competency-based learning
  - Western Governors’ University
- Internationalization
Assessment

- “Assessment = killer of learning” ++) alignment
- Multi-dimensional assessment: general education, key competencies, trajectory
- e-portfolios as self-evaluation and growth assessment instruments
Innovative pedagogical approaches

- Peer learning
  - Clickers / Flipped classroom

- Project and design based learning
  - Olin, Roskilde, Aalborg, Maastricht
  - Simulations
  - Serious games

- Self-learning using AI-based software
Advantages of peer learning

- Students know best how to communicate with each other
- Students may be more intelligent than their professors
- Students pay more attention to their friends than to the prof
- Professors are such experts that they don’t always know how to communicate their knowledge
- Students feel more at ease sharing their doubts with other students (fear, shame)
Learning Café, NUS
Gather clues - Interview suspects - Analyze evidence
Solve a mysterious death

This activity is set in a research group that is developing an antivenom for spider bites. In the opening scene, Nelson Pogline, a talented graduate student, dies unexpectedly at a university reception. As a detective, you must use chemistry concepts to determine if this was murder and if so, solve the case. You can interview suspects using Quicktime movies, investigate the crime scene for clues with Quicktime Virtual Reality images, and analyze the evidence from the crime lab.

This activity requires basic knowledge of formula weight, stoichiometry and the scientific method to solve the mystery.

Additional concepts that are discussed include: molecular recognition, limiting reagents, and mass spectrometry.

Note to instructors: The Windows-based software is suitable for high school and college introductory chemistry students. Mixed Reception can be used as a homework assignment for individual students, or as an in-class group activity. Solving the case takes between 40 and 50 minutes.

Activity and Materials:
Activity:
- Mixed Reception Activity [260 MB Zip file]
- Installation instructions

Classroom Materials:
- User Walkthrough [pdf]
- Activity Worksheet [doc]
- Periodic Table [pdf]
- Final Report [doc]

Classroom CD's:
(CD includes activity and classroom materials)
- Fill out a form to request free CD's
- Email us for teacher solutions and hints
- Download .iso file to make your own CD's

Please email us for additional information, or just to tell us what you think.
Olin College of Engineering

- Design-based learning (as teams)
- No academic departments / no tenure
- Integration of engineering, entrepreneurship and humanities
- Expiry principle
Stimulating learning environment?
MODES OF TEACHING AND LEARNING

• Hands-on Project-based Learning
• Laboratory-based Experiences
• Seminar/Discussion
• Interactive Lecture
• Student-based Independent Learning
• Team-based Independent Learning

At Olin, we teach, and students learn, in a variety of modes.
The new model

- Transfer of knowledge / construction of knowledge
- Follow instructions / follow your passion
- Learn in the classroom / learn 24 x 7
- Learn as an individual / learn in teams
Today

Postgraduate studies

First degree
Conclusion
Un vieillard qui meurt
est une bibliothèque qui... boute.
A brave new world?
Library of retired humanities professor in Maryland
Library of 21st century professor
Learning is not a spectator sport.
Competing in the learning society
Competing in the learning society
Competing in the learning society
Rule of the strongest
Rule of the most patient
What is your vision?
make your own path …