A Curricular Vision

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Northwestern University
A presentation found in a time capsule—
from the future!

Good evening, everyone! Welcome to tonight's lecture.

The Curricular Revolution: The View from Today
It may be hard to appreciate just how different education was, as late as the early 21st century.

Let me describe some of its more bizarre aspects, from curriculum to classroom.
Universities used to offer a long list of majors, like this!

<table>
<thead>
<tr>
<th>Aerospace Science &amp; Engineering</th>
<th>French</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American &amp; African Studies</td>
<td>Genetics</td>
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<tr>
<td>Agricultural &amp; Environmental Education</td>
<td>Geology</td>
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<tr>
<td>American Studies</td>
<td>German</td>
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<tr>
<td>Animal Biology</td>
<td>History</td>
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<tr>
<td>Animal Science</td>
<td>Human Development</td>
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<tr>
<td>Animal Science &amp; Management</td>
<td>Hydrology</td>
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<tr>
<td>Anthropology</td>
<td>International Agricultural Development</td>
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<td>Applied Mathematics</td>
<td>International Relations</td>
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<tr>
<td>Applied Physics</td>
<td>Italian</td>
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<tr>
<td>Art History</td>
<td>Japanese</td>
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<td>Art Studio</td>
<td>Landscape Architecture</td>
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<td>Asian American Studies</td>
<td>Linguistics</td>
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<td>Atmospheric Science</td>
<td>Managerial Economics</td>
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<tr>
<td>Biochemical Engineering</td>
<td>Materials Science and Engineering</td>
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<tr>
<td>Biochemistry &amp; Molecular Biology</td>
<td>Mathematical &amp; Scientific Computation</td>
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Majors in turn were made up of courses like this.

**SOPHOMORE LEVEL COURSES**

*Third Semester (17 cr)*

- ENGR 29700 - Computer Tools for Engineers
- MATH 26100 - Multivariate Calculus
- PHYS 25100 - Heat, Electricity, and Magnetism
- EEN 22000 - Fundamentals of Electrical Engineering
- ME 20000 - Thermodynamics I (3 cr)

*Fourth Semester (17 cr)*

- ECE 20400 - Introduction to Electrical Engineering
- MATH 26600 - Differential Equations
- EEN 24000 - Basic Mechanics (4 cr)
- EEN 26000 - Sustainable Energy (3 cr)
- ME 32700 - Engineering Economics

**JUNIOR LEVEL COURSES**

*Fifth Semester (16 cr)*

- ECE 40500 - Fundamentals of Electromagnetics
- EEN 33000 - Dynamic Systems Models
- ME 27200 - Strength of Materials (4 cr)
- EEN 31000 - Fluid Mechanics and Heat Transfer

*Recommended courses*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
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<tbody>
<tr>
<td>ANAT 101</td>
<td>Anatomy and Physiology I</td>
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<tr>
<td>ANAT 102</td>
<td>Anatomy and Physiology II</td>
</tr>
<tr>
<td>BMES 680</td>
<td>Special Topics: CAD/CAM in Biomedical and Tissue Engineering</td>
</tr>
<tr>
<td>MATE 661</td>
<td>Biomedical Materials I</td>
</tr>
<tr>
<td>MATE 662</td>
<td>Biomedical Materials II</td>
</tr>
<tr>
<td>MEM 444</td>
<td>Biofluid Mechanics</td>
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<tr>
<td>MEM 478</td>
<td>Computer-Aided Tissue Engineering</td>
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<td>MEM 684</td>
<td>Mechanics of Biological Tissues</td>
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<tr>
<td>MEM 685</td>
<td>Mechanics of Human Joints</td>
</tr>
<tr>
<td>MEM 686</td>
<td>Mechanics of Human Motion</td>
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</tbody>
</table>

http://.engr.iupui.edu/energy/plan.shtml

http://www.drexel.edu/catalog/plan/mech-biomechanical.htm
Most courses taught basic theory, applied to synthetic examples.

Real world practice came only after years of study.

http://www.seas.virginia.edu/acad/programs/engrsci/
A typical class schedule: lectures, quizzes, and a final exam.

https://www.e-education.psu.edu/egee120/node/47
Assessments at the end of a course determined grades. Grades defined success.

Students were thus discouraged from in-depth independent exploration. Faculty were pressured to "teach to the test."
Assessments measured ability to do the work for the course just finished.

Nothing measured ability to do future work. Nothing aligned courses to future needs.
Students in a class were of the same age, ideally with the same level of prior experience.
The teacher had two jobs: help the students learn, and assign grades.

Both sides felt the inherent conflict between those two functions.
By that time in history, computers and the Internet had dramatically changed business and social interactions.

Technology and Learning in the early 21st Century

So, how had technology changed education?
For the worse, mostly. Instead of removing compromises made to teach 30 or 100 students in a classroom...

...technology was used to compromise the education for thousands of students at a time.

- MOOCs
- flipped classrooms
- multiple choice quiz makers
- automated essay graders
- gamification
It's not that there weren't interesting ideas in how to improve learning.

Ideas in Learning in the early 21st Century
Many excellent ideas were explored on how to foster true collaborative team-based learning by doing... 

- collaborative learning
- project-based learning
- portfolios
- goal-based scenarios
- simulations
- serious games

...but they all missed the biggest problem.
If you put the wrong thing in the center of your theory...

Body of knowledge
... no amount of patching is going to save you.
The goal is "to be something."
So where are we now?

Education Today
Today, a university does not offer a collection of majors...

... but a set of contexts for learning, modeled on real life, where all students can explore a range of experiences and challenges.
Today, a major is not a collection of bodies of knowledge...

... but a progression of roles from novice to skilled practitioner.
A course is not a set of topic modules...

...but a sequence of increasingly challenging scenarios.
These scenarios occur within the venues, providing a familiar context that students return to over time.

**Corporate IT group**
- web site project
- web app project
- mobile app project
  - html / css
  - javascript, java
  - programming concepts
  - team project skills
  - logical reasoning
  - planning

**University research lab**
- compiler project
- distributed OS project
  - c/c++ programming
  - networks
  - formal languages
  - systems concepts

Through these repeated experiences, students learn both practical and general reasoning skills, and find areas where they wish to become experts.
Members in team-based scenarios are ideally not at the same "grade level" or in the same "major". Some may not even be students.

As in real life, learners in different roles may be at very different points in very different careers.
The total school experience is not one of separate silos, but interacting paths.

Collaboration and mentoring across ages and careers occurs constantly. Life-long learning is inherent in the process.
Instead of *final* exams...

... there are *entrance* exams, to assess readiness to pursue the next level of roles.
With progress measured by the roles and scenarios done, teachers are no longer graders. Their role is to coach, critique, mentor and inspire.

If you need current market data, a good place to look for might be...

- 1st-year CS
- 1st-year MBA
- 2nd-year designer
- 3rd-year user experience specialist
These changes were enabled by the intelligent use of technology.

Technology and Learning today
It all started when I got bored of us having to give people, every year, to king Minos of Crete. You might think that’s not too bad, and so did I until my dad told me that they were fed to a terrible beast called a minotaur. I thought I could go and kill it if I went with the people.
Technology enables just in time delivery of goal-based scenarios to ad hoc groups of students with diverse skills and careers...

Scenario Cohort Marketplace
Looking for a web developer (HTML5 and CSS skills a must!) and a project manager to work on "the eBay for artists scenario" <link>! Contact...

Run a Startup simulator
Newbie BME looking for a graduate level medical device designer and biz school entrepreneur to work on "the portable dialyzer scenario" <link>! Contact...

Peer review sites

Mentoring communities

... via a global marketplace of learners.
To summarize some of the key transformations in the education.

<table>
<thead>
<tr>
<th>Then</th>
<th>Today</th>
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<tbody>
<tr>
<td>departments</td>
<td>venues</td>
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<tr>
<td>knowledge-centered foundations-first curricula</td>
<td>role-centered practice-first curricula</td>
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<td>topic-driven lecture courses</td>
<td>challenge-based scenarios</td>
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<td>homogenous student cohorts</td>
<td>multi-skilled multi-career student cohorts</td>
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<td>backward-looking final exams</td>
<td>forward-looking placement exams</td>
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<tr>
<td>technologies for virtual classrooms</td>
<td>technologies for team-based immersive scenarios</td>
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Albert Willoughby
Apprentice Historian of Education
Public Presentation Challenge #2
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