The Fourth Industrial Revolution Meets the Fourth E-Learning Revolution
Curtis J. Bonk, Professor, Indiana University
http://mypage.iu.edu/~cjbonk/

Talk Overview
1. Basics of the 4th Industrial Age
2. Artificial Intelligence vs. Intelligence Augmentation
3. The Evolution of E-Learning
   (30 ways that learning is changing...)
5. Research on the Personalization of MOOCs
6. Future Trends and Ideas

Just what is the Fourth Industrial Revolution? Industry 4.0 (per Wikipedia)
https://en.wikipedia.org/wiki/Industry_4.0

April 13, 2016
The Fourth Industrial Revolution
Klaus Schwab, Founder and Executive Chairman, World Economic Forum
( Ubiquitous, mobile supercomputing, artificially intelligent robots, self-driving cars.
neuro-technological brain enhancements, genetic editing, etc.)

January 14, 2016
The Fourth Industrial Revolution: What it means, how to respond
https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

The possibilities of billions of people connected by mobile devices, with unprecedented processing power, storage capacity, and access to knowledge, are unlimited. And these possibilities will be multiplied by emerging technology breakthroughs in fields such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing.
**July 23, 2016**
Scientists work toward storing digital information in DNA
Malcolm Ritter, Phys.org

**August 3, 2016**
Researchers have built an artificial neuron:
Narrowing the gap between biological brains and electronic ones
The Economist

**July 15, 2015**
Neuro-technological brain enhancements
Wearable Vibes
A high-tech high: Wearable gives you good vibes, USA Today, John Shinal
http://www.usatoday.com/story/tech/columnist/shinal/2015/07/14/thync-hippie-culture/29774829/

**January 14, 2016**
The Fourth Industrial Revolution:
What it means, how to respond
Klaus Schwab, Founder and Executive Chairman, World Economic Forum
https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

**August 3, 2016**
"New Wave of Collaborative Robots"
Auto plant robots will interact with humans
USA Today, Brent Snavely, Detroit Free Press
http://www.usatoday.com/story/money/cars/2016/08/02/auto-plant-robots-interact-humans/87957648/

**March 22, 2016**
Robots & Artificial Intelligence Will Kill 5 Million Jobs By 2020
Carol Adl, Artificially intelligent robots
January 14, 2016
The Fourth Industrial Revolution:
What it means, how to respond
Klaus Schwab, Founder and Executive Chairman, World Economic Forum
https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

August 18, 2016
1. Deploying Swarms of Drones with...
2. The Driverless Truck is Coming and...
(e.g., Ryan Peterson, Flexport News/Blog)
https://www.flexport.com/blog/deploying-drones-self-driving-trucks/
https://www.flexport.com/blog/self-driving-truck-automation-of-million-jobs/
https://www.flexport.com/

August 26, 2016
Welcome to Larry Page’s Secret Flying-Car Factories:
With Zee.Aero and Kitty Hawk, the Google co-founder looks to the skies, Ashley Vance and Brad Stone, Bloomberg Businessweek

July 21, 2016
Facebook’s Aquila drone completes first test flight
Jessica Guynn, USA Today

An aerial view of Aquila, a autonomous aircraft Facebook is designing to deliver mobile broadband networks to isolated people (mission to fly 60,000 above Earth for up to 3 months at a time; current record for solar-powered unmanned flight is 2 weeks). (Photo: Facebook)

August 21, 2016
ST Future Economy Roundtable:
Is Asia ready for the Fourth Industrial Revolution?
The Straits Times
http://www.straitstimes.com/asia/is-asia-ready-for-the-fourth-industrial-revolution

“IT’s quite clear that the established models of education have to change and adapt to the new environment.”

Question:
What are the consequences for education and e-learning?
August 15, 2016
The Maker Movement in Education: A New Global Transformation
Paul Kim, ICT in Education, UNESCO

August 17, 2016
Research: 3D Printing Market to Double by 2020
Joshua Bolkan, Campus Technology

April 13, 2016
The Fourth Industrial Revolution: What it means, how to respond
Klaus Schwab, Founder and Executive Chairman, World Economic Forum
http://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/
http://www.tubechop.com/watch/8280981

August 21, 2016
ST Future Economy Roundtable: Is Asia ready for the Fourth Industrial Revolution?
The Straits Times
http://www.straitstimes.com/asia/is-asia-ready-for-the-fourth-industrial-revolution
"We need cyberhackers and coders in this area, we need game design, interface design. Constantly updating is part of this lifelong learning that begins in your teenage years."

June 7, 2016
Teaching refugees how to code, CNN Money

June 20, 2016
Coursera on a Mission to Help Refugees
Lauren Camera, US News and World Report
July 28, 2016
Knod
(Per Dr. Michael Mayrath: work with employers to diagnose skills gaps, then provide a platform to deliver content to build those skills in a learn by doing experiences, real projects with employers)
http://www.knod.net/

June 14, 2016
Microsoft to Acquire LinkedIn for $26.2 Billion,
Jay Greene, CNN Money

Poll:
Read any good books lately detailing this shift?

The Inevitable (2016)
What Technology Wants (2010)
Kevin Kelly (co-founder of Wired)

The Innovators:
Walter Isaacson (2014)
http://books.simonandschuster.com/The-Innovators/Walter-Isaacson/9781476708690

The Third Wave:
http://www.thirdwavebook.com/
Machines of Loving Grace: 
The Quest for Common Ground Between 
John Markoff (2015) 
http://www.amazon.com/Machines-Loving-Grace-Common/dp/0062266683

Artificial Intelligence 
John McCarthy, Stanford AI Lab

March 14, 2016 
Artificial Intelligence and Robots

Intelligence Augmentation and Amplification
Douglas Engelbart’s “The Mother of All Inventions” (1968) 
Augmentation Research Center (ARC)

Letsee is an AR app from a South Korean company that allows consumers to scan a product and see a series of product reviews instantly overlaid overtop.

June 3, 2016
Virtual Reality Lets Med Students Experience What It’s Like To Be 74
Elyse Wanshel, Huffington Post 
http://ht.ly/b5pe300XEP3
April 10, 2016
Virtual reality tested by NFL as tool to confront racism, sexism
Marco della Cava, USA Today

One VR diversity demo places the user in the body of an African-American woman as a white male avatar gets aggressive mere feet away. (In one Stanford VR demo, subjects are made to feel what it is like to be homeless, as in this scene where the user is transported into the body of a woman riding the bus with a few possessions.)

Knowledge Navigator (1987)
Apple Computer
http://www.youtube.com/watch?v=hb4AzF6wEoc

April 3, 2010
The iPad

October 14, 2011
Siri (co-founder Tom Gruber)
http://www.imore.com/siri

August 22, 2016
Microsoft acquires AI assistant start-up Genee
Marco della Cava, USA Today (Cortana)

May 9, 2016
Personal Digital Assistants (PDA)
Personal digital assistants are on the rise (and they want to talk)
USA Today, Edward Baig (i.e., Google codename of "Chirp"), Elizabeth Weise, USA Today
August 30, 2016
New Siri to work with apps in iOS 10, but not all
Jefferson Graham, USA Today

Questions: How will PDA’s work in education? Who builds them? And who decides the functions?

April 23, 2015
Are We Living In An eLearning Revolution?
Beth Wisch eLearning Industry

The World is Flat...
People, Playing Field, Horizontal Processes

The World is Open...
Piping, Pages, Participatory Learning Culture

The World is Open:
How Web Technology Is Revolutioning Education
April 13, 2016

The Fourth Industrial Revolution:
“The World is Really Open to Learning”
http://trainingshare.com/text-clip.php

August 5, 2015

Shubham Jaglan (10 years old) Overwhelmed by “Dream” Return Home After Double World Championship
Disha Chagori, NDTV Sports

April 20, 2015

250 MOOCs and Counting: One Man’s Educational Journey, Chronicle of Higher Education
http://chronicle.com/article/250-MOOCs-Counting-One/229397/?cid=at

Jima Ngei: “I had this unrelenting fear that this miracle of free access might evaporate soon.”

July 2016

I. Elaine Allen and Jeff Seaman, Babson Survey Research Group

January 15, 2016

Wikipedia is 15!
Scott McLemee, Inside Higher Ed
April 4, 2016
MIT OpenCourseWare is 15!
http://ocw.mit.edu/about/15-years/

August 6, 2016
The Web is 25!
Happy (sort of) birthday, World Wide Web,
Erica Fink and Jonathan Tortora, CNN Money (Tech)
http://info.cern.ch/ (first website)
http://info.cern.ch/hypertext/WWW/TheProject.html

1971
Email is 35 years old!
Raymond Tomlinson, inventor of modern email, dies, USA Today (March 7, 2016)

Invented: May 24, 1844
150 Years since Lincoln needed the Telegraph (T-Mail)
Mr. Lincoln’s T-Mails: How Abraham Lincoln Used the Telegraph to Win the Civil War, Tom Wheeler (2008).

30+ Ways Learning is Changing:
The Mega Trends

How Learning is Changing:
Mega Trend #1. Learner Engagement

- social
- hands-on
- visual
- touch-sensored
- game-based
- adventurous
- digital & resource rich
- immersive
- collaborative

Learner Engagement
Pervasive Access
Customization & Personalization
Decades of Online Collaboration
(e.g., Aspects...circa 1991—25 years ago)

August 23, 2016 (Engagement)
Reef Videoconferencing
(Great Barrier Reef, Australia)

July 14, 2016 (Engagement)
Shindig
http://events.shindig.com/event/ftf-wheeler

July 22, 2016 (Engagement)
When Pokémon Goes to Campus:
The Good, the Bad, and the Ugly
Gabriel Sandoval, Chronicle of Higher Education
http://chronicle.com/article/When-Pok%C3%A9mon-Goes-to-Campus-The-Good-the-Bad-and-the-Ugly/237219?cid=trend_au&elqTrackId=c60af7ea6da640ec98d260eb7af9ef66&elq=95ace8ab293b4a5ead1a353c0e6f0dfc&elqaid=9961&elqat=1&elqCampaignId=3667

Pokémon Go players converged last week on the U. of Nebraska at Lincoln’s Memorial Stadium, which officials had opened to the animated-monster hunters. The hit augmented-reality game has prompted many colleges to jump on the bandwagon.

July 11, 2016 (Engagement)
Smart Sparrow, Learning Design Studio
Virtual Patients: This suite of applications were developed at UNSW in exercise physiology that simulates real-life medical procedures and tests including the taking of vital pressure and the monitoring of a patient’s heart rate. These applications have interactive and engaging graphics as well as adaptive feedback.
https://www.smartsparrow.com/case-studies/virtual-patients/

August 24, 2016 (Engagement)
Changing opinions on climate change, from a CNN meteorologist, Chad Meyers, CNN
August 2, 2016 (Engagement)
Mystery whale has scientists shocked,
New Whale Species Discovered, CNN

Want “FREE” engagement? How about “Adding Some TEC-VARIETY”?
http://tec-variety.com/

How Learning is Changing: Mega Trend #2. Pervasive Access

How Learning is Changing: Mega Trend #2. Pervasive Access

August 15, 2016 (Access)
The Informal Learning Paradox
My Observations (Charles Jennings), LinkedIn
http://charles-jennings.blogspot.com/2016/08/70-20-10-origin-research-purpose.html

The Age of Videopedia…
July 18, 2016 (Access)
Survey: Video Usage in Ed Continues Ramp-up,
Dian Schaffhauser, THE Journal
http://reviews-bonuses.net/videopedia-pro-1-0-reviews-bonuses/

May 4, 2016 (Access)
What I Learned at the ASU GSV Summit
Kenneth Green, Inside Higher Ed
http://www.eschoolnews.com/asugsvsummit/
September 14, 2015 (Access)
Credit for Watching a TED Talk? A new platform aims to help employers track casual learning
Chronicle of Higher Education, Jeffrey R. Young
Degreed: https://degreed.com/

June 20, 2016 (Access)
The Expert Cafe
http://expertscafe.com/

June 20, 2016 (Access)
Noodle
https://www.noodle.com/

June 13, 2016 (Access)
Nine-Year-Old Anvitha Vijay is the Youngest Developer at WWDC (age 9)

May 4, 2016 (Access)
This Mongolian Teenager Aced a MOOC
Now He Wants to Widen Their Impact
(140,000 people took the MIT MOOC on Circuits and Electronics, 1 of 300 to get a perfect score)
The Chronicle of Higher Education, Jeffrey R. Young
http://chronicle.com/article/This-Mongolian-Teenager-Aced-a-MOOC/236362

May 19, 2016 (Access)
From MOOC to bootcamp to MIT
MIT News, Office of Digital Learning
(Jin Wu—from MITx to MIT Global Entrepreneurship Bootcamp to master’s student)
How Learning is Changing:
Mega Trend #3. Customization

**August 1, 2016 (Customization)**
363 by Idea Group; Study Café Meeting Place; Idea Space

**May 20, 2016 (Customization)**
agMOOCs (India)
http://www.agmoocs.in/

**August 14, 2016**
Data From the 2016 Almanac (as of May 2016)
Chronicle of Higher Education
http://chronicle.com/interactives/almanac-2016?cid=cp51#id=37_502

**January 5, 2016**
Use Of MOOCs And Online Education Is Exploding: Here’s Why
Josh Bersin, Forbes
http://www.forbes.com/sites/joshbersin/2016/01/05/use-of-moocs-and-online-education-is-exploding-heres-why/#290acdda7f09

**August 12, 2016 (Customization)**
Class Central’s Top 50 MOOCs of All Time,
Dhawal Shah, Class Central Blog
“Now there are close to 6,000 MOOCs from 600+ universities around the world.”
July 27, 2016 (Customization)
Class Central
https://www.class-central.com/zh-CN/collections/free-online-courses

August 12, 2016 (Customization)
A Life of Happiness and Fulfillment
Indian School of Business, Rajagopal Raghathan
https://www.class-central.com/collection/top-free-online-courses

August 5, 2015 (Customization)
How Nanodegrees Are Disrupting Higher Education
John Waters, Campus Technology
http://campustechnology.com/articles/2015/08/05/how-nanodegrees-are-disrupting-higher-education.aspx

January 13, 2016 (Customization)
Degree gets you a tech job — or your money back
Marco della Cava, USA Today

January 20, 2016 (Customization)
Coursera Specializations
https://www.coursera.org/browse?utm_medium=email&utm_source=marketing&utm_campaign=aUAR4L-fEeW6i-NodUB9Qw&languages=en

July 28, 2016 (Customization)
Coursera Specializations email
Starting Monday August 1st: 9 Top Specializations
### July 28, 2016 (Customization)

**Udemy: “Get cozy with a class”**

[https://www.udemy.com/](https://www.udemy.com/)

### MOOCs and Open Education Around the World


### July 1, 2015 (Customization)

**Chapter 14: Creating a Temporary Spontaneous Mini-Ecosystem through a MOOC**

Paul Kim and Charlie Chung, Stanford University

Figure 2. Twitter thread announcing the MOOC

### June 14, 2016 (Customization)

**World First: University of Michigan’s Dr. Chuck Holds a Graduation Ceremony for MOOC Students**

Anuar Lequerica, Class Central


### March, 2016

**MOOCWatch March 2016: Learning with MOOCs III**

Anuar Andres Lequerica is Class Central’s analyst

- Coursera announced it has reached 18 million learners and 3.6+ million course completions.
- The University Of Michigan plans to launch at least 200 MOOCs by 2017, and its b-school has reached more than one million.
- The University of Pennsylvania’s Wharton School is close to reaching three million enrollments.
- The number of South Korean MOOCs is expected to surpass 100 this year.
- Only 18% of adults are familiar with MOOCs.

### August 24, 2016

**K-MOOCs (and ocMOOCs and hMOOCs)**

Revolutionizing online education

Professor creates courses tailored to cultural differences

Kim Jonghak Doisy, Bong-Moon Kim

[http://www.kmooc.kr/](http://www.kmooc.kr/)
Some edX numbers that blew my mind:
- 8.3 million (unique) learners on the edX platform.
- Between 2012, when edX started, and today - there have been 27 million course enrollments.
- Over 1,000 courses have been offered.
- Over 2,300 faculty and staff have taught on edX.
- Over 840,000 certificates earned by edX learners.

Question: How to personalize--artificial intelligence or intelligence augmentation?

MOOC Personalization Survey Results

1. How many MOOCs have you taught? (N = 152)

3. How many MOOCs have you completed as a learner (N = 152)
7. What is the delivery format of your most recent MOOC?

<table>
<thead>
<tr>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>High or demand-paced MOOC</td>
</tr>
<tr>
<td>Partially learner-paced (i.e., a-cMOOC)</td>
</tr>
<tr>
<td>Instructor led on all teaching activities</td>
</tr>
</tbody>
</table>

8. How many people signed up for your most recent MOOC (N = 150)?

<table>
<thead>
<tr>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10,000</td>
</tr>
</tbody>
</table>

13. How do you address students’ varying competencies and needs? [Check all that apply]

<table>
<thead>
<tr>
<th>Answer Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish learner-based discussion forums</td>
</tr>
</tbody>
</table>

14. What types of learning resources can participants select from in your most recent MOOC? [Check all that apply]

<table>
<thead>
<tr>
<th>Answer Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written forum or thread</td>
</tr>
</tbody>
</table>

16. In what ways is peer interaction encouraged in your MOOC? [Check all that apply; N = 137]

<table>
<thead>
<tr>
<th>Answer Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigning pair-based assignments or peer</td>
</tr>
</tbody>
</table>

17. How did you design your course to be suitable for students from different cultures and/or linguistic backgrounds? [Check all that apply]

<table>
<thead>
<tr>
<th>Answer Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offer transcripts of video or audio content</td>
</tr>
</tbody>
</table>

9/17/2016
18. Does the structure of your most recent or current MOOC provide any of the following? [Check all that apply; N = 126]

- Learner portfolios of course accomplishments
- Teacher or instructor feedback
- Facilitator or teaching assistant feedback
- Embedded agents for student advice
- Other (Please describe):
  - Peer or group member reports

19. How is student progress/participation monitored or tracked? [Check all that apply; N = 137]

- Automated grading system
- Automated alerts for missed assignments
- Automated group allocation tools
- Automated plagiarism checking/detection (e.g., Turnitin.com)

20. In what ways do students get feedback in the course? [Check all that apply; N = 135]

- Instructor feedback
- Peer feedback
- System or computer feedback
- Other (Please describe):
  - Face-to-face meet ups (e.g., cafés, study center, university, etc.)

21. Does your most recent (or current) MOOC utilize any of the following? [Check all that apply; N = 127]

- Automated grading system
- System or computer feedback
- Peer or group member reports
- Instructor feedback

22. How do participants in your MOOC contact you if they have questions, concerns, or suggestions? [Check all that apply; N = 135]

- Email to the course or system
- Email to the instructor
- Social media
- Automated alerts for missed assignments
- Automated group allocation tools
- Automated counseling system
- Automated plagiarism checking/detection (e.g., Turnitin.com)
- Instructor feedback

February 2016
NMC Horizon Report > 2016 Higher Ed Edition
http://www.nmc.org/publication/nmc-horizon-report-2016-higher-education/

September 15, 2015
GROOCs are MOOCs for Social Impact
Social Learning for Social Impact, edX
Join the world’s first GROOC – a MOOC for groups – to collaborate with others globally and create social change.
http://www.edx.org/course/social-learning-social-impact-mcgillx-groocx

May 4, 2016
MOOC 4.0: The Next Revolution in Learning & Leadership
Otto Scharmer, Huffington Post

August 31, 2016
Samsung ticks forward with new Gear S3 smartwatch
Edward C. Baig and Eli Blumenthal, USA TODAY

September 2, 2016
Humans, the Latest MOOC Feature
Introduction to Philosophy: God, Knowledge and Consciousness
($300 USD for an identity-verified certificate)
Carl Straumsheim, Inside Higher Ed

September 7, 2016
Learning Apps - Personalized Interfaces for Performance
Elliott Masie’s Learning TRENDS; trends@masie.com
Personalized for an employee based on their development goals, competency gaps and changing skill/information matrix in the workplace. A Learning App could provide a just in time set of content, context, collaboration connections, coaching sets and real time feedback.
Learninggoal: https://www.learninggoal.com/services/apps-for-learning
September 21, 2016
What happens when the Fourth Industrial Age meets the Fourth E-Learning Age?...
Welcome to “The Learning Century”

- Where will learning reside or be stored? (watches?)
- How will we treat artificial agents and PDAs?
- Will they be learning guides and tutors or teachers?
- Will nanodegrees become highly accepted and expected?
- What will your resume/CV look like in the year 2030?

Talk Reminder

1. Basics of the 4th Industrial Age
2. Artificial Intelligence vs. Intelligence Augmentation
3. The Evolution of E-Learning
   (30 ways that learning is changing...)
5. Research on the Personalization of MOOCs
6. Future Trends and Ideas

Remember: “The world is really open to learning”

The Fourth Industrial Revolution
[Link to video]

Any Questions or Comments?

Slides at: TrainingShare.com
Papers: PublicationShare.com
Email: curt@worldisopen.com