

# 4차 산업혁명 시대, 대학 혁신의 방향

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# Contents

1. 4차 산업 혁명이 요구하는 인재상
2. 대학 교육의 변화
3. 혁신생태계의 허브가 되기 위한 대학의 혁신

# 1. 4차 산업혁명이 요구하는 인재상

# Education for Disappearing Jobs?

- Within next 10 to 20 years, **about 47% of all jobs in the U.S. are threatened by automation** (Frey and Osborne, 2013).
  - Number of manufacturing jobs in the U.S. almost halved from 21 million to 12 million during the past 35 years.
  - In contrast, the number of smart labors in high-tech sector such as Internet, Scientific R&D, Pharmaceutical, Software have increased (Moretti, 2012).
- **65% of children entering primary school today will eventually work in jobs that do not yet exist** (World Economic Forum, 2016).

# Execution & Conceptual Design Capabilities

## Execution Capabilities

- Capacity to interpret a given blue print and to materialize it physically using resources
- Easy to transfer as they are manualized in many cases, and there exists learning-by-doing
- Efficiency gains (speed and costs) through repeats
- When developing countries receive skill educations based on manuals during the early development period, they absorb them easily most of the time.
- With accumulating experience, developing countries can make efficiency improvements themselves, making it possible to raise their execution capabilities themselves.

## Conceptual Design Capabilities

- Capabilities to define a concept of a product and a service firstly, to draw a picture in a blank paper, and to make originals
- The core of the conceptual design capabilities is the scaling up. It is the core capability of global champion companies and is the pre-requisite of open innovations.
- Because conceptual design capabilities have no manual and because they are accumulated in person/organizational culture as creative tacit knowledge, it is impossible to transfer
- The only way to build conceptual design capabilities is through learning-by-building; field + learning-by-doing and endless challenges are pre-requisites of generating originals

# ROBOT-PROOF



**HIGHER EDUCATION**  
IN THE AGE OF  
**ARTIFICIAL INTELLIGENCE**

JOSEPH E. AOUN

## **Northeastern 2025**

Higher education needs a new model and a new orientation away from its dual focus on undergraduate and graduate students.

Universities must broaden their reach to become engines for lifelong learning.

College should shape students into creators.

# New Literacies

- **Data literacy** to read, analyze, and use these ever-rising tides of information
- **Technological literacy** gives a grounding in coding and engineering principles, so they know how their machines tick
- **Human literacy** teaches them humanities, communication, and design, allowing them to function in the human milieu.

# Higher-Order Mental Skills

- **Systems thinking:** the ability to view an enterprise, machine, or subject holistically, making connections between its different functions in an integrative way
- **Entrepreneurship:** the creative mindset to the economic and often social sphere
- **Cultural agility:** how to operate deftly in varied global environments and to see situations through different, even conflicting, cultural lenses
- **Critical thinking:** instills the habit of disciplined, rational analysis and judgment.

## 2. 대학 교육의 변화

# South Korea leapfrogged in 3<sup>rd</sup> Industrial Revolution, but is now facing daunting challenges in 4<sup>th</sup> industrial revolution.

From Mass Production System

Toward Mass Customization System

1<sup>st</sup> 1784

mechanical production



steam power energy

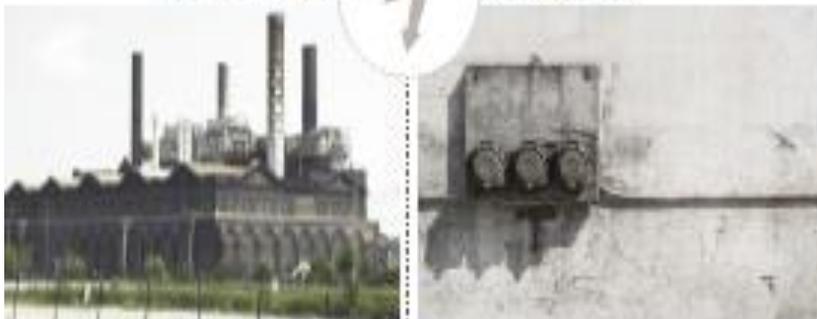


2<sup>nd</sup> 1870

mass production



electrical energy



3<sup>rd</sup> 1969

electronics



IT



4<sup>th</sup> Today

artificial intelligence



big data

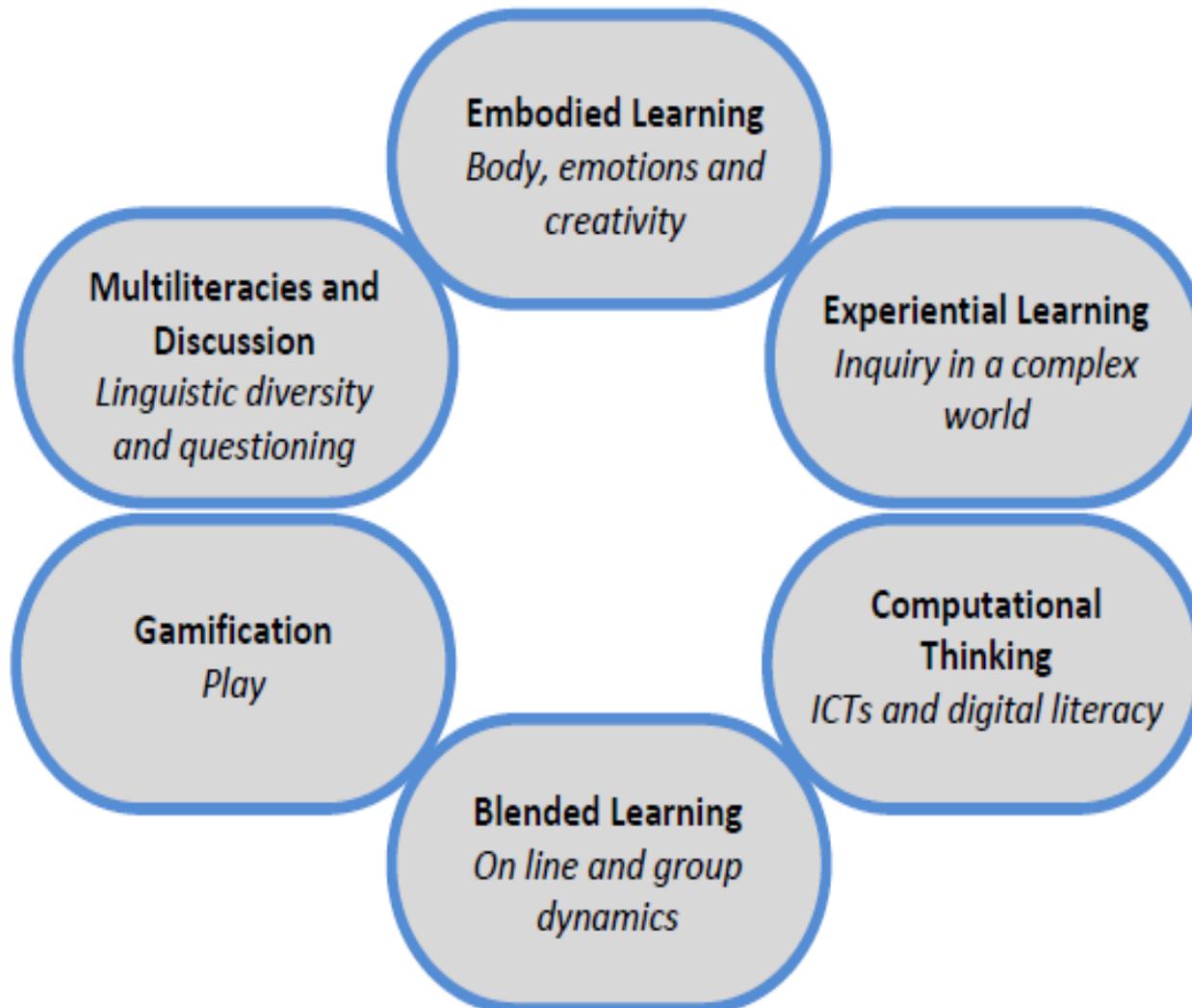


# From Mass Production to Mass Personalization

- **Learn to Test**  **Learn to Learn**
- **Shallow Learning**  **Deep Learning**
- **Vertical Learning**  **Horizontal Learning**

# Teachers as Designers of Learning Environment

Figure 4.1. Clusters of innovative pedagogies



# Experiential Learning

- Northeastern's co-op program is a full-fledged experiential learning model that includes partnerships with 3,300 employers in more than 130 countries
  - A typical undergraduate embarks on her first co-op for six months during sophomore year.
  - To match students with co-ops, the university maintains a sizable network of coordinators who work with both students and employers, as well as career development coordinators who work with students.

# Personalized Life-long Learning

- Universities will co-design curricula in full partnership with employers and learners.
  - Shifting from a “build it and they will come” educational model to a model that is built around the learner.
- Instead of fitting it into old categories such as undergraduate and graduate courses, we can chunk it into smaller modular blocks that can be assembled according to learners’ targeted objectives.
  - As more universities implement ways to deliver content in modular, stackable forms that are customized to learners’ needs, teaching faculty across disciplines are likely to collaborate more often.

# Rise of Multi-University Network

- the multi-university network is a multi-location entity existing across multiple states and even multiple countries
  - Northeastern University with locations in Boston, Charlotte, Seattle, and Silicon Valley as well as a non-U.S. location in Toronto.
  - Each node of the network is connected to the other, such that learners can circulate through it to take advantage of academic programs, learning resources, and experiential learning opportunities
  - In many ways, it is the next logical iteration of a university, taking into account the forthcoming need to serve a growing population of lifelong learners.

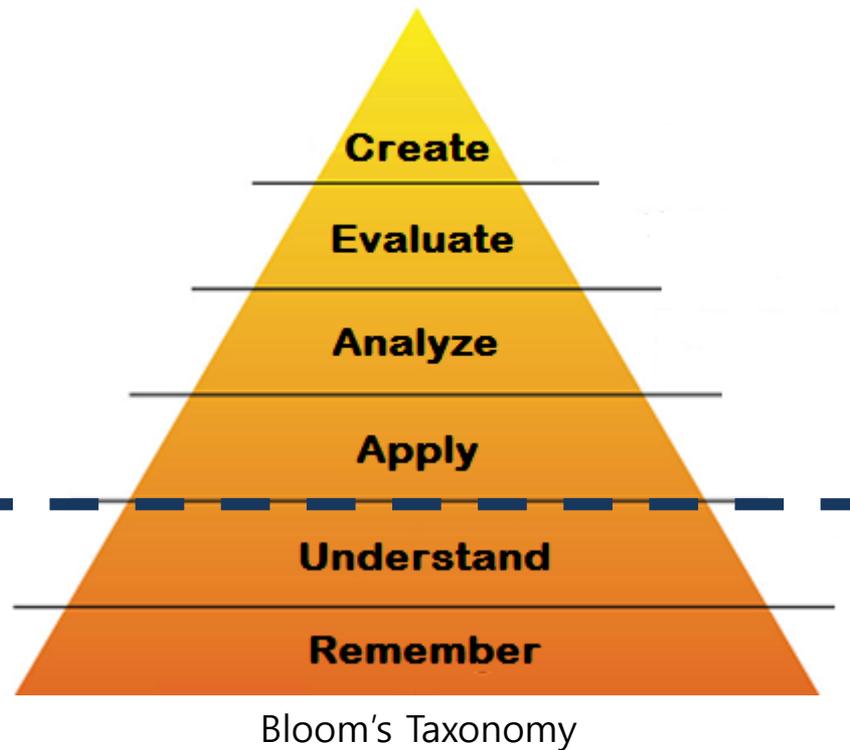
# Learning Revolution in Arizona State University

- “New American University” Model by Arizona State University
  - ① In contrast to the elite universities that maintain excellence by only selecting top performing students,
    - ✓ ASU aims to enhance both student body inclusiveness and quality of education and be “measured not by those whom we exclude, but rather by those whom we include and how they succeed.”
  - ② ASU president Michael Crow argues that since the 19<sup>th</sup> century, institutional revolution of university has only been incremental, and because universities have been constrained to the traditional structure, they have not been producing researches that help community by addressing the changed needs of society.
    - ✓ Rather than replicating the traditional university system of Harvard or Berkley, he asserts that universities should seek unique characters and identities

# Best results with “High-Touch and High-Tech” Learning

High-Touch  
(Project-Based Learning)  
With Teachers

High-Tech  
(Adoptive Learning)  
With AI and Mobiles



Example of Arizona State University (ASU)

Source: Johnson (2018)

# Use of Education Technology at Arizona State University

- Adaptive Learning

- ① Computerized courseware provides adaptive feedback to what each student is doing
  - ② Computer suggests educational pathways based on performance of each student
  - ③ Professors adjust courseware based on their experience with students
- ✓ Online classes that utilize adoptive learning provide conceptual learning while hands-on learning such as laboratory experiments are taught in small groups
  - ✓ Started with mathematics, it is now expand to include physics, biology, and chemistry
  - ✓ Dropout/failure/withdrawal rate of adaptive learning is at 6% in contrast to the 20% of traditional lecture model

# **ASU Experience** with adaptive systems

- **Over 65,000 ASU students have benefited from adaptive learning systems**

**Biology** - CogBooks

**Chemistry** - McGraw Hill LearnSmart

**College Algebra** - McGraw Hill ALEKS

**College Math** - Pearson MyMathLab with Knewton

**Economics** – Cengage Learning Objects

**General Science** - SmartSparrow

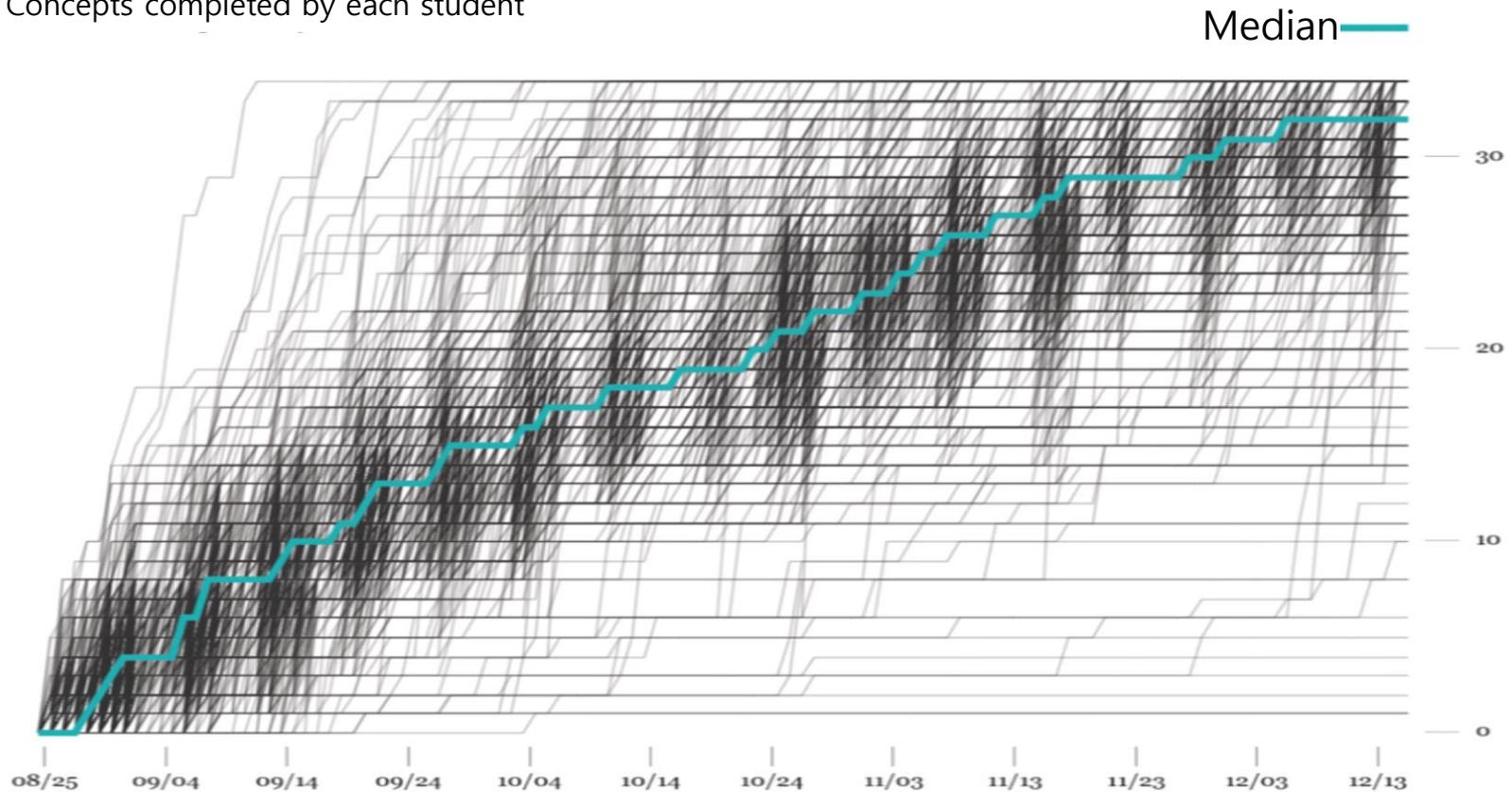
**History** - CogBooks

**Physics** - Pearson Mastering Physics

**Psychology** – Cengage Learning Objects

# Why do something new?

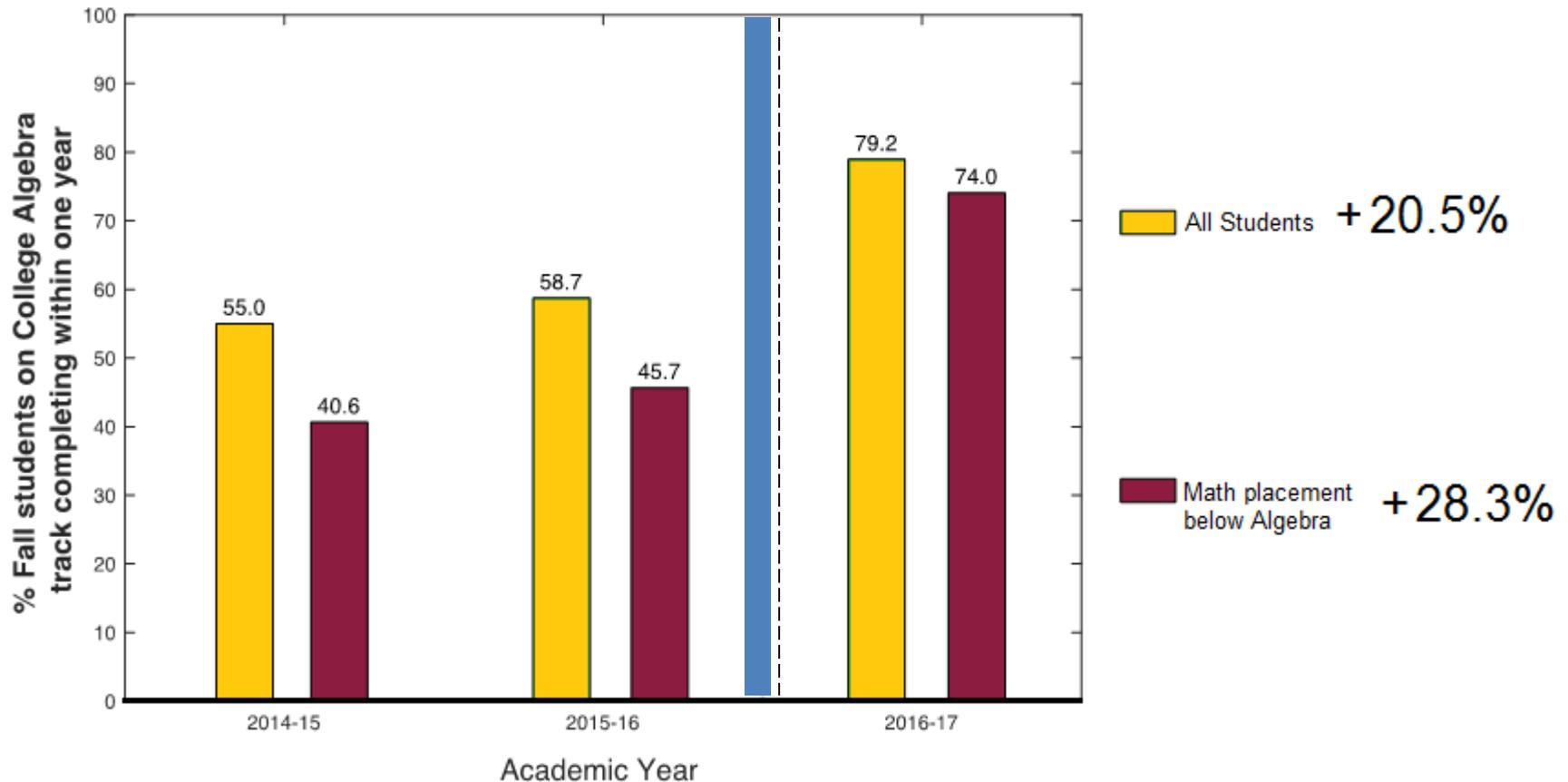
ASU College Math  
August to December 2012  
Concepts completed by each student



Source: Johnson (2018)

# How has it worked for ASU?

## College Algebra – Fall '16 switch to ALEKS adaptive math system



\* ~ 5000 students per year; Same curriculum and assessments

Source: Johnson (2018)

# Project-Based Learning and Academic Industrial Cooperation at Arizona State University

- The College of Technology and Innovation at Arizona State University
  - ① All classes are centered around projects in which students solving problems faced by local companies or community at large
  - ② Over the course of last 10 years, ASU has abolished 69 academic units and created 30 new interdisciplinary units
- Partnership between Arizona State University and Starbucks
  - ① Tuition rebate if Starbucks employee register for ASU online courses
  - ② As of 2015, 1,500 low-income Starbucks employee registered

# Use of MOOC at Arizona State University

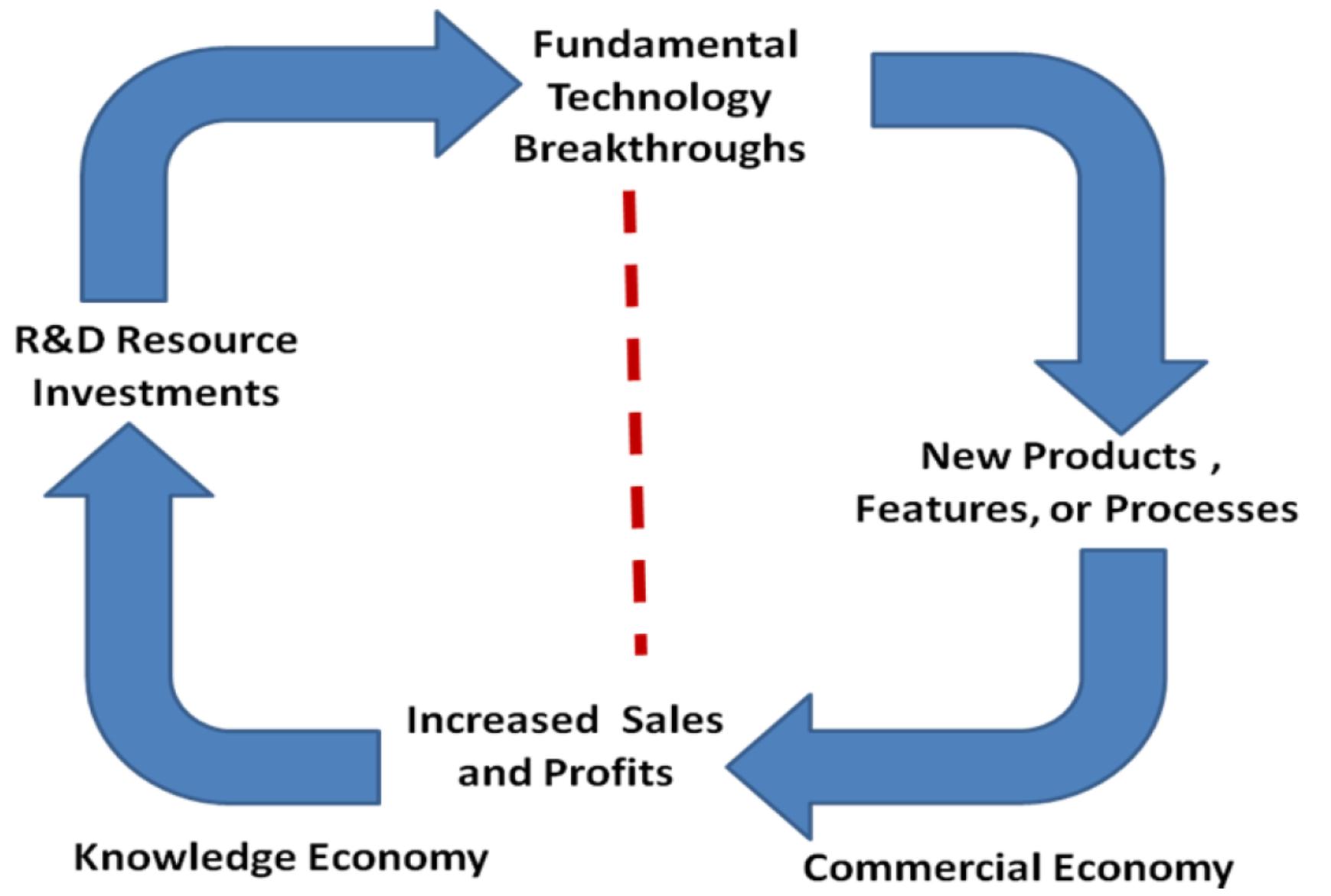
- Global Freshman Academy
  - ① Partnership between edX and MOOC(Massive Open Online Course) to launch of Global Freshman Academy
  - ② Courses are free to attend, but to receive credits, students must pay \$45 for identity verification process and \$200 per credit
  - ③ Students can save as much as \$4,000 per year
- ✓ Arizona State University currently provides 10 freshman courses through edX and is planning to expand the list to 12.

### 3. 혁신생태계의 허브가 되기 위한 대학의 혁신

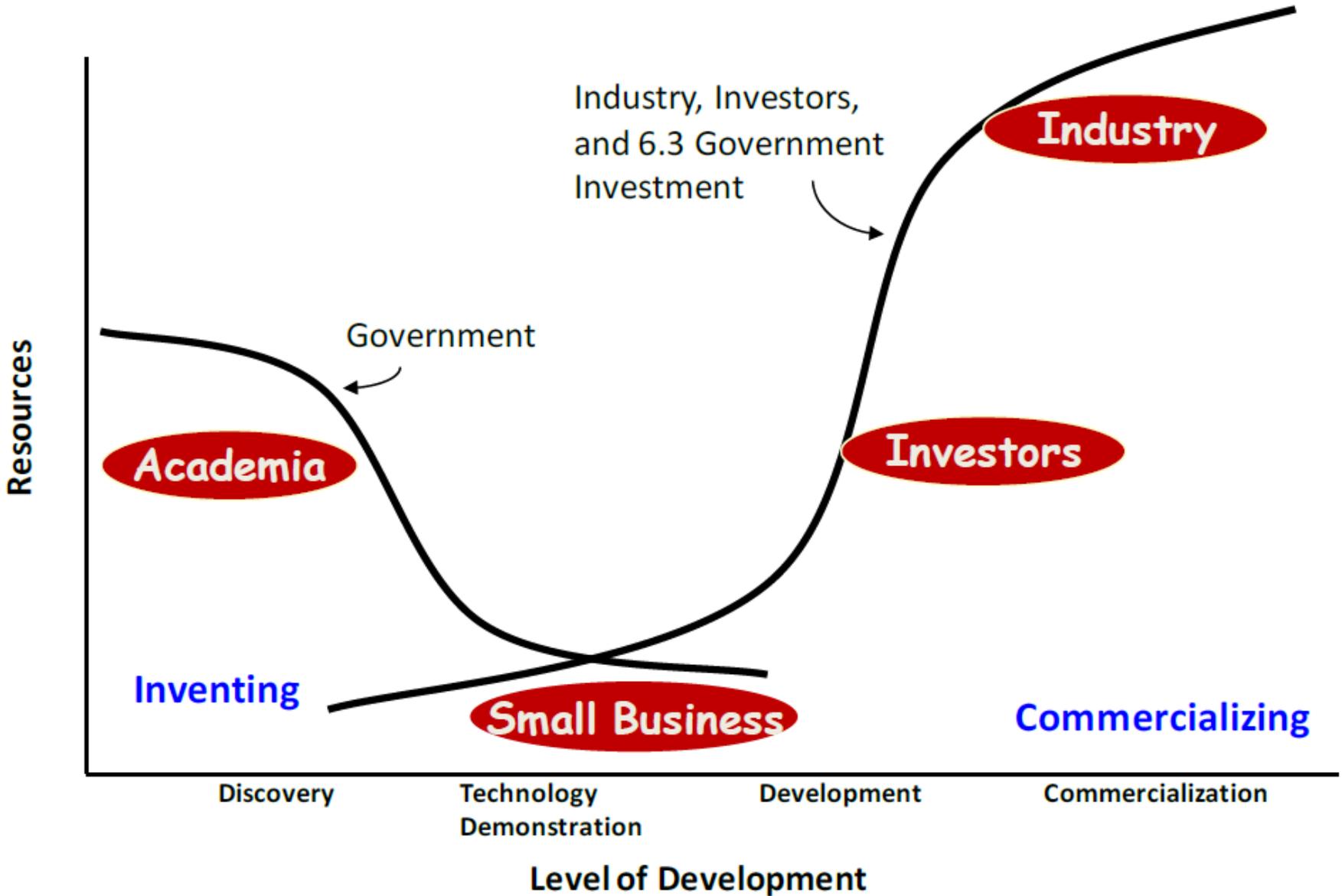
# Universities as Central Hubs of the Innovation Ecosystem

- Companies may also collaborate with other corporations in the same or different fields, but it is to academia that they increasingly turn for:
  - ① Exposure to leading-edge thinking and technology, and insight from internationally recognized experts.
  - ② Objective advice on strategic decision-making, related to new products and to implementing innovative management practices.
  - ③ Research partnerships.
  - ④ Recruitment of skilled employees with fresh perspectives and state-of-the-art knowledge who can become future company leaders.

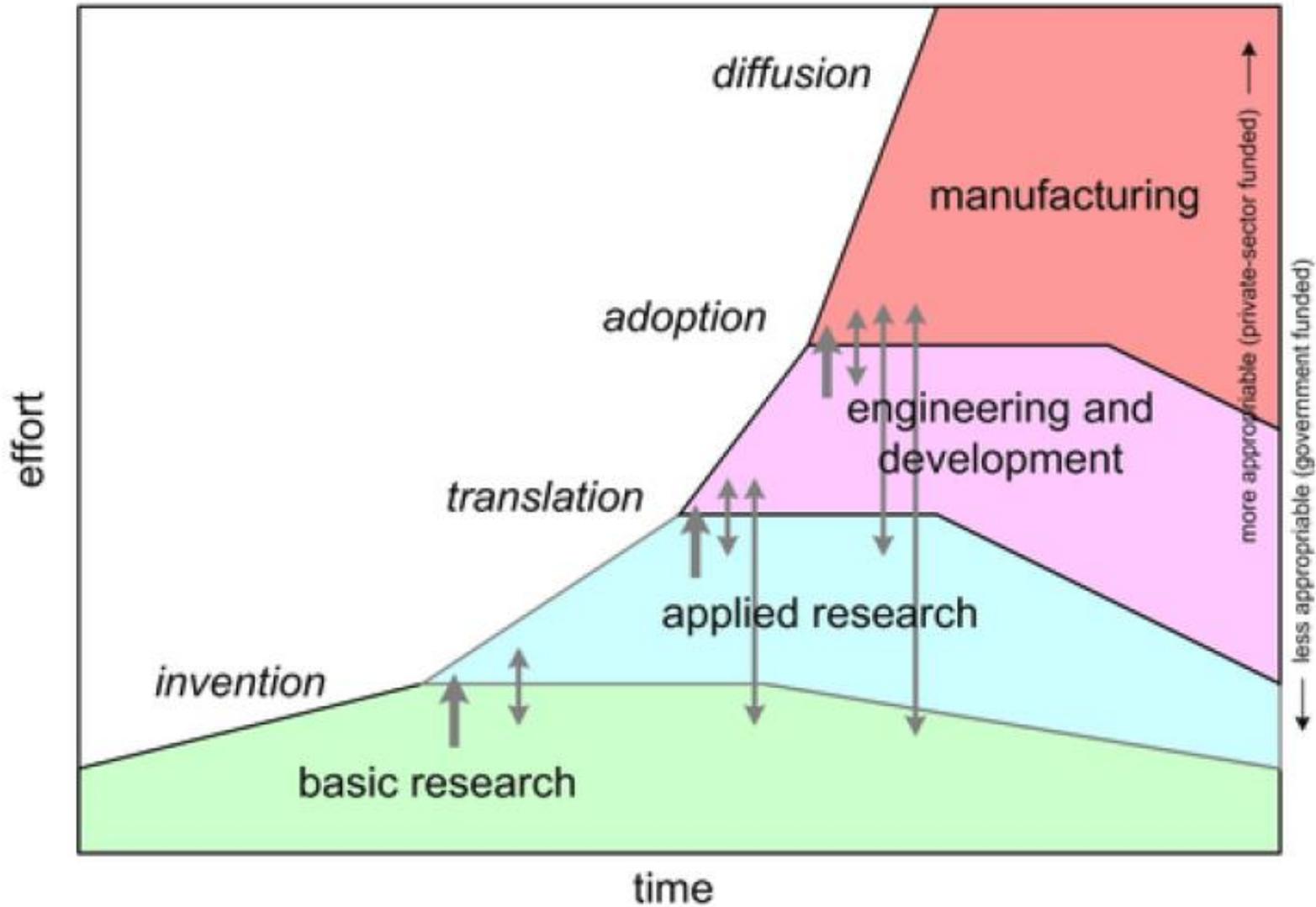
# Virtuous Cycle



# Valley of Death



# Interacting Technology Stages



# Transdisciplinary Research Enterprise of Arizona State University

- Traditional departments and colleges were disbanded to create interdisciplinary units that tackle social and future problems such as water shortage and exploration of the Solar System
- Departments of Geology and Astronomy were combined to create the **School of Earth and Space Exploration**, which aims to pull together expertise in engineering, computation, and Earth and space science
- Furthermore, with the creation of various other interdisciplinary departments such as the **School of Human Evolution and Social Change**, many traditional departments including biology, sociology, anthropology, and geology were eliminated

**TABLE I. ACADEMIC REORGANIZATION AT ARIZONA STATE UNIVERSITY**

New Unit	Former Units
School of Government, Politics and Global Studies	Department of Political Science and School of Global Studies
School of Design Innovation	Department of Industrial Design, Department of Interior Design, and Department of Visual Communication Design
Herberger Institute for Design and the Arts	College of Design and Herberger College of the Arts
W. P. Carey School of Business	W. P. Carey School of Business, School of Global Management and Leadership and Morrison School of Management and Agribusiness
School of Social Transformation	Departments of Justice and Social Inquiry and Women’s Studies, plus programs in African and African-American Studies and Asian-Pacific American Studies
School of Historical and Critical Inquiry	Departments of History, Philosophy, and Religious Studies
School of Sustainable Engineering and the Built Environment	Department of Civil and Environmental Engineering and Del E. Webb School of Construction
School of Electrical, Computer and Energy Engineering	Departments of Electrical Engineering and part of Department of Computer Science and Engineering
School of Biological and Health Systems Engineering	Departments of Bioengineering and Biomedical Informatics
School of Computing, Informatics and Decision Systems Engineering	Department Computer Science and Engineering and Department of Industrial, Systems and Operations Engineering
School of Life Sciences	Departments of Biology, Plant Biology, Microbiology and some faculty from Departments of Philosophy and History
School of Nursing and Health Innovation	Departments of Nutrition and Exercise Science and School of Nursing
Disestablished College of Human Services	Units in this college went to other colleges
College of Technology and Innovation	Six departments merged to three

Thank you for your attention.

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