The Frontier for the Future Workforce

Reginald Brothers, Ph.D.
Ashley Gierlach, M.A.
Near & Far

Educational Requirements

Implications for Future Workforce

Future Vision

Historical Global Context

Near & Far Term Educational Requirements
I. Historical Global Context: Industrial Revolutions
A Fourth Industrial Revolution:

1st industrial revolution
Through introduction of mechanical production facilities with the help of water and steam power
End of 18th century

First mechanical weaving loom 1784

First assembly line 1870

2nd industrial revolution
Through introduction of mass production with the help of electrical energy
Beginning of 20th century

First programmable logic control system 1969

3rd industrial revolution
Through application of electronics and IT to further automate production
Beginning of 1970s of 20th century

4th industrial revolution
On the basis of cyber-physical production systems (CPPS), merging of real and virtual worlds
Today

World Economic Forum
Near & Far

Educational Requirements

Implications for Future Workforce

Future Vision

Historical Global Context

Near & Far Term Educational Requirements
II. A Future Vision: Global Dimensions and Emerging Tech

Accelerating Pace of Technology

Black Swan Syndrome

Industry overtakes Government in applied R&F spending

Disruptive Business Models

Expanding Global Knowledge Base

Artificial Intelligence/Machine Learning

Distributed Collaboration

Technological Convergence
II. A Future Vision: Complex Interrelationships

- Science
  - Brain $\rightarrow$ neuroscience $\rightarrow$ AI
  - Mathematics $\rightarrow$ math formalism $\rightarrow$ software assurance
  - CS/Material Science $\rightarrow$ AI chips
  - Mathematics+CS+life sciences = Omics
  - Behavioral Sciences
  - Quantum +CS = Quantum Computation
  - What is the ‘Science-Vector’?

- Technology
  - AI- thinking tech
  - AR/VR – Visualization tech
  - Robotics – doing tech
  - Energy sources/storage
  - Engineered biology
  - 3D Manufacturing
  - Distributed identity platforms

- Policy/Law/Ethics
  - Intersection with science and tech
  - Insufficient frameworks
    - Speed and agility $\leftrightarrow$ overall theme
Agility, Speed and efficiency is essential

User-Producer Innovation + Wide-Aperture Search
III. Implications for the Future Workforce
Human labor was historically cheaper than machine labor, but in the context of the current technological innovation we are experiencing, machine labor is beginning to become cheaper than human labor.
III. Implications for the Future Workforce: The “Human-Machine Teaming Balance”

- Human Workload
  - Human Decision Making “Workload”
  - Minimum Human Operator Oversight (Level set by policy, legal and ethical frameworks)

- Machine Workload
  - Machine Decision Making “Workload”
  - AI-Based Decision Making

(Advancements in Autonomous Technology)
III. A vision of the future workforce

“Centaur”

Centaur trans-disciplinary teams

2017 Super Bowl

Innovation

Wetware

Hardware

Innovation

Software
Near & Far

Educational

Requirements

Implications for Future Workforce

Future Vision

Historical Global Context
IV. Near & Far Term Educational Requirements

“A key idea emerging from many conversations is that changes in educational and learning environments are necessary to help people stay employable in the labor force of the future”

Two main priorities:

• *Diversifying education and credentialing ecosystem*: Most experts see a new education and training ecosystem emerging and expect the education marketplace – especially online learning platforms – to continue to change in an effort to accommodate the widespread needs.

• *A focus on nurturing unique human skills that artificial intelligence (AI) and machines seem unable to replicate*: The human talents that machines and automation may not be able to duplicate should be the skills developed and nurtured by education and training programs to prepare people to work successfully alongside AI. Experts suggest that workers of the future should learn to deeply cultivate and exploit creativity, collaborative activity, abstract and systems thinking, complex communication, and the ability to thrive in diverse environments.

*Pew Research Center*
Five major themes about the future of jobs training in the tech age:

<table>
<thead>
<tr>
<th>HOPEFUL THEMES</th>
<th>CONCERNS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theme 1</strong></td>
<td><strong>Theme 4</strong></td>
</tr>
<tr>
<td>The training ecosystem will evolve, with a mix of innovation in all education formats</td>
<td>Training and learning systems will not meet 21st-century needs by 2026</td>
</tr>
<tr>
<td>- More learning systems will migrate online. Some will be self-directed and some offered or required by employers; others will be hybrid online/real-world classes. Workers will be expected to learn continuously.</td>
<td>- Within the next decade, education systems will not be up to the task of adapting to train or retain people for the skills that will be most prized in the future.</td>
</tr>
<tr>
<td>- Online courses will get a big boost from advances in augmented reality (AR), virtual reality (VR) and artificial intelligence (AI).</td>
<td>- Show me the money. Many doubts hinge upon a lack of political will and necessary funding.</td>
</tr>
<tr>
<td>- Universities still have special roles to play in preparing people for life, but some are likely to diversify and differentiate.</td>
<td>- Some people are incapable of or uninterested in self-directed learning.</td>
</tr>
</tbody>
</table>

**Theme 2** | **Theme 3** |
---|---|
Learners must cultivate 21st-century skills, capabilities and attributes | New credentialing systems will arise as self-directed learning expands |
- Tough-to-teach intangibles such as emotional intelligence, curiosity, creativity, adaptability, resilience and critical thinking will be most highly valued. | - While the traditional college degree will still hold sway in 2026, more employers may accept alternate credentialing systems as self-directed learning options and their measures evolve. |
- Practical, experiential learning via apprenticeships and mentoring will advance. | - The proof of competency may be in the real-world work portfolios. |

**Theme 5** | **Theme 5** |
Jobs? What jobs? Technological forces will fundamentally change work and the economic landscape | |
- There will be many millions more people and millions fewer jobs in the future. | |
- Capitalism itself is in real trouble. | |

Pew Research Center, Elon University & Imagining the Internet Center
IV. Near & Far Term Educational Requirements

Historical issues to consider:

1. Lack of adaptability
   - Designated order of classes: factory model (antiquated)
   - Limited recognition of different learning styles
     • Learning is a perishable skill
     • Retraining non-lifetime learners
2. Prejudice
3. Fear

Solutions via education:

1. Innovation
   • Agile curriculum (electronic printing)
   • Design Thinking
2. Computational thinking
   • First level: Programming language (second language)
   • Second level: Machine compatible thinking and norms
3. Collaboration
   • Human-Human Teams
   • Human-Machine Teams (norms/ social cognitive)
IV. Near & Far Term Educational Requirements

The Key to Success = Innovation

Speed & Agility – Flow/Zone – Challenging Assumptions