Reinventing Education

The Impact of Automation, Innovation & Technology

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State Workforce Innovation Council
Future of Work Taskforce

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Game Changers

Harmonization and Integration of Many Disciplines and Discoveries

• Various titles: Fourth Industrial Revolution, Second Machine Age, Digital Convergence, Industry 4.0

• Characterized by the convergence/integration of:
  • Artificial Intelligence (AI)
  • Internet of Things (IoT)
  • Cloud Computing
  • Data Science and Analytics

• Fusion of technology across the physical, digital, and biological worlds
Top 10 skills

in 2020
1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgment and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility

in 2015
1. Complex Problem Solving
2. Coordinating with Others
3. People Management
4. Critical Thinking
5. Negotiation
6. Quality Control
7. Service Orientation
8. Judgment and Decision Making
9. Active Listening
10. Creativity

Taught in Context

Source: Future of Jobs Report, World Economic Forum
The World has Fundamentally Changed

Where are all the Jobs?

- Detroit 1990 – three biggest companies
  - Combined market cap of $36 billion, revenue of $250 billion, and 1.2 million employees

- Silicon Valley 2014 – three biggest companies, none of which existed in 1990
  - Combined market cap of $1.09 trillion, revenue of $247 billion, but with about 10 times fewer employees at 137,000

- Wealth is generated in the Digital Age today with fewer workers compared with 10-15 years ago
  - Digital businesses have marginal costs that trend toward zero

K-12 flawed approach to learning

• Our current K-12 system was developed in the early 1900’s to serve the needs of the Industrial Age

• K-12 then became college preparation focused in the latter half of the 20th century
  • This turned off generations of students who did not learn well in a learning environment devoid of applications

• 2001 No Child Left Behind Act
  • Led to a fixation on testing
  • Further focused teaching and learning on literacy and numeracy
The problem

• The disenfranchised student- today only 9% of young adults from the lowest income quartile will complete a BS degree by age 24.

• Among the 48,000 Indiana high school graduates in 2014 who took the SAT, only 101 college-bound African Americans and 156 Latinos had SAT scores and GPAs in the range of the average Purdue freshman.

• Among that same set of graduates, only 7 college-bound African Americans and 16 Latinos had SAT scores and high school GPAs in the range of the top 15% of Purdue freshmen.
The problem

- 93% of employers say:
  
  “a demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than a candidate’s undergraduate major.”

- More than 75% of employers want higher education to place more emphasis on
  
  • Critical Thinking
  • Complex Problem Solving
  • Written and Oral Communication
  • Applied Knowledge

- High Schools are not preparing college bound students to learn these 21st century skills

The Challenge: Educating for the 21st Century

Educate students for:

- Life in a time of profound change
- Life in a digital age
- Life in a diverse and global society
- Life in an evolving information economy
- Life for jobs that do not exist today
REINVENTING HIGH SCHOOL
PURDUE POLYTECHNIC HIGH SCHOOL INDIANAPOLIS

TRANSFORMING EDUCATION TO MEET STUDENT, SOCIETY AND INDUSTRY NEEDS
Purdue Polytechnic Platform School

- Built on evidence-based best practices
  - Focused on integration of core academic subjects with STEAM topics
  - Designed in the new digital ecosystem
- Partners: Purdue, industry, and community Co-developing curriculum and Co-teaching
  - Professional development for teachers
  - Regular visits to Purdue, internships, industry mentors and projects
- Students can complete the equivalent of an associate degree and certificates in high school
- Competency-based education
- Structural changes resulting in transformational learning
The Union 525 S. Meridian—tech venue for start-up and growth companies
Opened in 1885 as Industrial Training School and then renamed in 1911 as E. Manual High School
Located close to industry partners—sits in between Rolls Royce and Eli Lilly campuses
Each cohort will be 150 students beginning with 9th grade and adding 1 grade per year
Priority admission for IPS students
Total enrollment in 2021-22 school year: 600
Continuing to explore options for 2018 +
  - PR Mallory
  - New Construction by Union 525
  - Other commercial sites
By the Numbers

- Total Students Enrolled – 154
  - Male – 65% Female – 35%
- Place of Residence
  - Indianapolis Public Schools (Center Township) – 61%
  - Other townships and outside of Marion County – 39%
- Ethnicity
  - African-American – 35%
  - Hispanic – 21%
  - White – 34%
  - Other – 10%
- Special Education – 13%
- English Language Learner – 19%

Status

- Just completed the first Design Challenge
  - Indianapolis Zoo was the corporate sponsor
  - Challenge was “How to increase awareness of conservation in Indianapolis”
- Students participated in multiple events
  - NASA – Orion spacecraft team
  - Boiler Business Exchange football tailgate at Monument Circle
  - FailFest – Entrepreneurs and business leaders talking about learning from failure
  - PitchFeast – Student project winners pitching solutions to community members
- Academic progress moving forward
  - Variety of teacher-led and on-line resources
  - Baseline testing shows 65% of students at grade level; 15% above; 20% below
  - Students are required to acquire academic skills and then apply them within their projects
Model Overview

• Everything starts with the Design Challenge
  • 4-6 weeks in length
  • Broad subject areas
• Teachers design workshops and dojos (small seminars) and offer them at various times during the week
  • Workshops are taken by every student and relate academic content to the broad subject
    • i.e. Linear Equations and Elephant Populations
  • Dojos are taken by students who need instruction on a specific skill
    • i.e. Understanding and solving Linear Equations
• Students schedule themselves into workshops and dojos on a weekly basis
  • A student might have 8 workshops and 5 dojos to attend in a week
  • Time not scheduled in a workshop or dojo is spent doing
    • Project group work
    • Personal Learning Time
      • On-line, using various software tools and websites
      • In our learning labs, using teachers and community/business mentors or peers as learning resources
• In addition, students also must design a small group project that relates to the Design Challenge
  • They work with their Personal Learning Coach (teacher) to get the project approved and report progress
  • Following the Design Thinking Process, students arrive at a solution and do a “Pitch” to their Personal Learning Community
    • Each PLC selects a winner, then the winners to a final pitch to the entire student body and our business partner for a final winner
The Purdue Polytechnic High School

Leading in the transformation of high school learning

- Teachers are mentors and coaches
- Students responsible for their learning
- Integrated learning with the humanities, science and math
- Design thinking and innovation as foundations
- Team-based, industry sponsored, learn-by-doing activities integrated throughout the Polytechnic curriculum - from freshman year classes through senior-capstone design projects and internship experiences
- Automatic admission into Purdue
- Model school to be replicated in communities across Indiana
High school is inspirational and challenging

You get to do work that was meaningful to you and that leads to the requisite credentials for graduation and post-secondary

Every day is different and filled with new opportunities

Failure is treated as a great opportunity to learn, not as something to fear

Learning occurs inside and outside of the school walls

Instruction comes seamlessly from school staff, business and industry mentors, and peers

You have the opportunity to work on, and solve, problems that happen in your neighborhood, city, state, nation and world

You leave high school knowing how to learn, and comfortable with the idea that there are rarely hard and fast right and wrong answers
Competency-based Education

1. Students advance upon demonstrated mastery
2. Direct and measurable learning objectives empower students
3. Assessments are meaningful and a positive learning experience for students
4. Students receive rapid, differentiated support
5. Learning outcomes emphasize creation, application, integration, transfer of knowledge

Learning is the constant: NOT Time!
How can the Indianapolis Zoo develop interventions to increase local conservation efforts?

How will Indiana contribute to the challenge of feeding nine billion people without overwhelming the planet by 2050?

How can the Indy Fuel enhance player and fan experience to drive success both on the rink and at the ticket booth?
Higher Education Challenges

Historical Context
Historical Context

Higher Education’s Foundation Has Very Old Roots

- Morrill Land Grant Act 1862
- First exceptional research university, John Hopkins, 1876
- Creation of the credit hour in 1906 (Carnegie Unit)
- Adopted a hybrid approach found in German and British universities to meet the needs of a growing and technologically advanced society
- Today’s research universities took final shape in the 1930’s and began ascent following WWII and the GI Bill
- The common core developed at Harvard in 1945
- All developed within Industrial Age economy
Cracking the Credit Hour

Constraint to Innovation

• The Carnegie Unit in its 1906 Annual Report stated explicitly, “in the counting the fundamental criterion was the amount of time spent on a subject, not the results attained”

• We have subdivided ourselves into 3-credit hour “knowledge units” defined by individual disciplines and individual faculty rather than by the knowledge needed to address complex problems
Industrial Age Teaching and Learning

What needs to change

- Structure and curriculum have not kept pace with the evolution of business and industry and technological progress
- Education is too much like the world of work of the industrial age
  - Punctuality, attention, and silence
  - Standardized tests
  - School is managed for the students
  - Students are rewarded for having answers, not asking questions
- Life after school demands self-directed learning to prepare graduates for jobs that do not exist today.
- Digital age graduates must navigate the ambiguity of today’s jobs with a mix of discipline knowledge/skills and “refinement skills” of communications and writing, creativity and problem solving, and working in teams.
Why Polytechnic?

**Our definition**

- The 21\textsuperscript{st} century version of the Polytechnic:
  - New \textbf{discipline/way of doing} for the thinking and creative economy
  - Aligned with needs of business and industry

- Our new definition of “polytechnic”:
  - A way of teaching that uses innovative learning methods, real-world experiences, and industry partnerships to produce graduates uniquely qualified for STEM professions
Polytechnic Learning Innovation

Envision – Plan – Act – Refine

• A college dedicated to learning innovation and systemic cultural change to inform
  • Higher education (Purdue and beyond)
  • K-12 education (Polytechnic HS system)

• Testing new paradigms
  • Adapting to changing needs of students & employers
  • Learner-centered – Trusting students with their learning
  • Experimentation with faculty roles – coaches and mentors
  • Informed by research and experience
### Ten elements of transformation

Requires significant advancements within each element, not minor evolutionary changes

<table>
<thead>
<tr>
<th>Element</th>
<th>Details</th>
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<tbody>
<tr>
<td>Theory-Based Applied Learning</td>
<td>Learning-by-doing is core to the Polytechnic experience &amp; requires an increased use of lab courses and/or in-class applied-learning activities</td>
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<tr>
<td>Team Project-Based Learning</td>
<td>Responding to industry, more team project-based learning is needed, and this should also include instruction on team dynamics/techniques</td>
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<td>Modernized Teaching Methods</td>
<td>Improve student learning by replacing less effective traditional lectures with “Active Learning” methods – see “Cone of Learning” on CIE web</td>
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<tr>
<td>Learning in Context</td>
<td>Provide a richer learning experience via a purposed-based, just-in-time manner – requires inter-disciplinary synchronization – very challenging</td>
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<td>Integrated Humanities Studies</td>
<td>Adjust courses/curricula to reap benefits of studying humanities within STEM framework; integration with TECH 120 is a model for years 2, 3, 4</td>
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<tr>
<td>Competency Credentialing</td>
<td>Create competency-based majors or degree programs by leveraging work done for college’s recently-approved transdisciplinary degree</td>
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<td>Senior Capstone Projects</td>
<td>All plans of study should include a required two-semester senior capstone experience that is driven by industry or community partners</td>
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<td>Internships</td>
<td>All degree programs should include a required internship or other workforce-like activity that is facilitated by the college and department</td>
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<tr>
<td>Global/Cultural Immersions</td>
<td>All plans of study should include a required activity that gives students an enriched perspective of the cultural-driven global marketplace</td>
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<td>Faculty-to-Student Mentorship</td>
<td>A hallmark of the Polytechnic experience is the opportunity for every student to have a faculty mentor for professional guidance &amp; support</td>
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Strategic Successes

Enrollment Growth

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<td>New Beginners</td>
<td>502</td>
<td>575</td>
<td>627</td>
<td>753</td>
<td>822</td>
<td>+63.7%</td>
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<td>Total Enrollment</td>
<td>3638</td>
<td>3746</td>
<td>3855</td>
<td>4072</td>
<td>4377</td>
<td>+20.3%</td>
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- Exceeded all Purdue Moves enrollment targets last 3 years
- Outpaced university’s WL growth: 63.7% vs 19.5%; 20.3% vs 7.2%
- Popular new majors: Cybersecurity; Game Development & Design
- Continued strength in traditionally high-enrollment majors: Mechanical/Electrical/Aeronautical Engineering Tech, Computer and Information Tech, Professional Flight, Construction Management Tech

Transformation [Purdue Moves]

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<tr>
<th>Transformation Component</th>
<th>ATT</th>
<th>CGT</th>
<th>CIT</th>
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<th>TLI</th>
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<td>Applied Learning &amp; Learn-by-Doing</td>
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<td>Active-Learning “Lecture” Methods</td>
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<td>Competency-based Programs</td>
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<td>Industry-based Senior Capstone Project</td>
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<td>Internships and Workforce-like Activity</td>
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- Progress being made across all 10 components of the college’s transformation
- Expect additional areas to “go green” this academic year
- Integrated curriculum, integrated humanities studies, and competency-based programs are particularly challenging to scale-up across entire college

Purdue Polytechnic HS Indianapolis

- Opened on schedule with every seat filled
- Innovative project-based STEM curriculum
- Offers pipeline opportunity to attend Purdue
- Strong community, corporate, and foundation support
The Grand Challenge

• Education reform has not kept pace with the accelerating pace of technological change.
• Rethink how we do education for the digital age to address workforce education needs.
  • This is especially true for the majority of K-12 students that do not pursue a BS degree.
  • No student should graduate from high school without one or more of these:
    • high valued certificate,
    • progress towards an associate degree,
    • fully prepared to pursue a BS degree,
    • motivated lifelong learner
Thank you

Questions and Answers

“We never educate directly, but indirectly by means of the environment. Whether we permit chance environments to do the work, or whether we design environments for the purpose makes a great difference.”