

Purdue Polytechnic Educational Research and Development
Education for the Thinking Economy
Education for the Millenials

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Give a woman a fish and feed her for a day. Teach a woman how to fish and feed her as long as there is a good supply of fish. Teach a woman how to think creatively and she will feed herself and her community for a lifetime.

0. Introduction, Motivation

The premise that higher education in its current state brings an essential, invaluable, and unique value to society is being increasingly challenged. This challenge is real and we would be remiss to ignore it or minimize it. What is at stake is not only the role and place of Higher Education in society, but more importantly, the role and place of our children in their world and the health of the socio-economic and ecological systems in which they will live. It is our duty to exercise the highest form of scholarship and intellectual integrity in re-examining the foundations of this system, rethinking its premises, and designing and taking the necessary actions to create a better world and brighter future for our youth.

The world around us is changing in *fundamental* ways. These are changes in the *nature* and not just in scale. Yet, in the world of education, changes remain incremental and very cautious¹. The difference in speed in change is creating a widening gulf between the world of academic education and the rest of our day to day reality. Academia is still educating for the fast disappearing Knowledge Economy. Indeed, knowledge, the formerly staple of Academia, has become a commodity that is abundant, ubiquitous, consumed, and produced by the masses. Most of our professional degrees are still designed to prepare graduates for the cognitive structured jobs; which jobs are being automated away fast (see for example *Dancing with Robots* (Murnane, *Dancing with Robots: Human skills for computerized work*, 2013) or *Smart Machines* (Hamm, 2013)). Indeed, the new economy is no longer a Knowledge Economy; it is a *Thinking Economy* with completely different demands and expectations. Furthermore, the students we are serving have changed in fundamental ways. Their preoccupations, aspirations, and ways of learning, working, and playing are dramatically different from ours and are a reflection of their time (Wagner, *The Global Achievement Gap: Why Even Our Best Schools Don't Teach the New Survival Skills Our Children*

¹ At the first IBM T-summit <http://tsummit2014.org/> the most passionate calls for change are those of Academic career services personnel who witness on a day to day basis the dichotomy between the speed of change in industry and the stability in academia.

Need—and What We Can Do About It , 2010). Yet, we still teach what we have learned and how we have learned it. Our youth are not us, and we should not be trying to turn them into us. They are very concerned about the future, about their place in the world. They are generally more interested in doing something significant than in making money. They understand that the future presents new challenges and opportunities. They understand the magnitude of these challenges and are worried about their ability to face them. They are excited about the infinite opportunities available to them and are worried about their ability to see these opportunities and seize them.

1. The PPI Project

The Purdue Polytechnic Institute is a Big Move² sponsored by the President Office at Purdue. It was created in the Fall of 2013 as a separate entity that emerged from the College of Technology with the goal to rethink and innovate technology education outside the norms and constraints of the usual protocols and traditions. Its virtual decoupling is meant to allow it sufficient freedom of decision and action. Its existence within the College of Technology and Purdue University allow it to benefit from the institutional resources and support. The Purdue Polytechnic has strong partnerships within Purdue, notably with the College of Liberal Arts at Purdue. Other Purdue partners include DLRC, CIE, and IMPACT. Outside partners include Olin College and California Polytechnic.

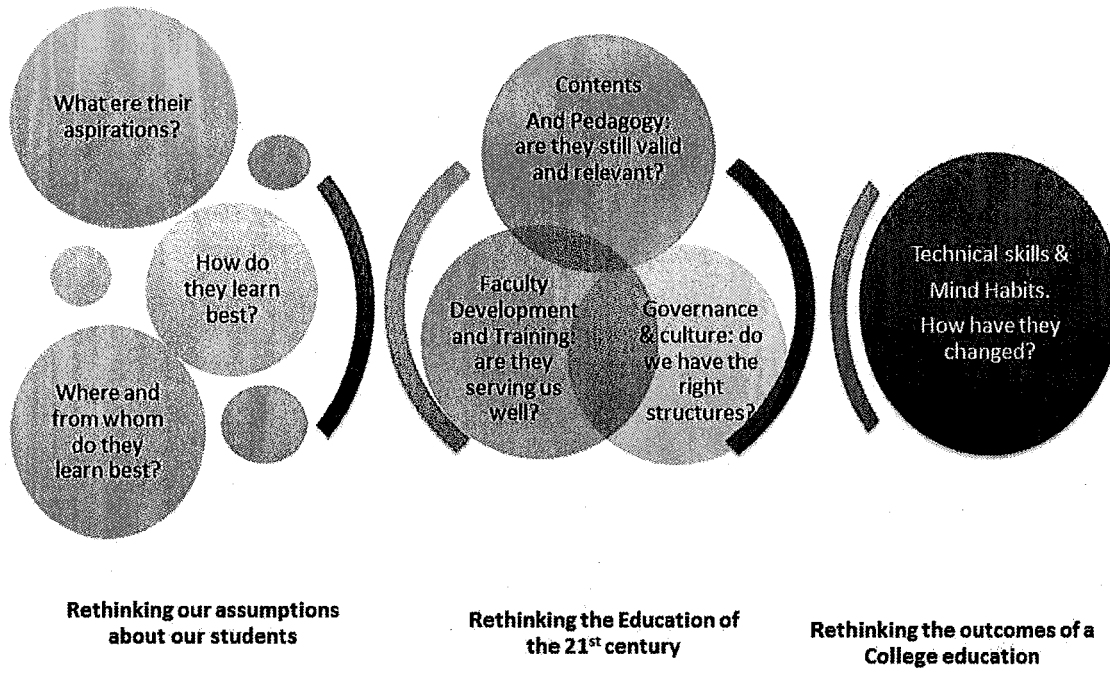
2. The PPI Research and Development Mission

The mission of the PPI Educational R&D is to serve as a laboratory for higher education of the 21st century. This mission is driven by the observation that the current educational system is no longer a good fit for the economy and no longer a good fit for the students it is meant to be serving. The R&D aims of PPI are to address the following three questions:

1. The students: Are incoming students different from the students for whom the current educational system was designed? If so in what way? What are the assumptions and values about the students that need to be reviewed and revised?
2. The economy: Does the economy of the near and long term future demand different graduate characteristics than those that the current higher education has been targeting? If so, how? Are there skills we are cultivating that have become irrelevant? Are there new skills for which we are not preparing?
3. The education: How well is the current educational system meeting the needs of the students and the economy, and what can be done to increase the fit? Based on the findings to the first two questions, what aspects of what we do and how we do it need to be revised and changed?

These three questions are summarized in the Figure below and are addressed briefly in turn.

² <http://www.purdue.edu/newsroom/releases/2013/Q3/daniels-provides-additional-details-on-purdue-campus-initiatives.html>



The PPI Mission

2.1 Rethinking our assumptions about the students

The question:

Are incoming students different from the students for whom the current educational system was designed? If so in what way? What are the assumptions and values about the students that need to be reviewed and revised?

The Hypothesis: We are serving a new, bigger, and different student population.

There is extensive research and documentation on the fact that current and future students differ from students in the past in some significant ways and in ways that have a direct impact on what they want, what they are prepared for, what they expect from their education, and what affects their motivation and success in education and in life. We mention some highlights here pointing to key references.

1. The demographics are different: A higher education degree is becoming an expectation and an economic necessity for all.
2. The aspirations are different: Several studies show that younger generations are more concerned with doing something significant in their life than they are with making the bottom

line for their employers (Levine, 2012) (Wagner, The Global Achievement Gap: Why Even Our Best Schools Don't Teach the New Survival Skills Our Children Need—and What We Can Do About It , 2010).

3. They have different work and learning habits: They come to us with a strong track record in interest-based exploration and learning (Brown, 2011) and in learning through exploration and discovery from and with others (Price, 2013). They are also used to creating, collaborating, and sharing. Most of these characteristics come from learning through gaming and social media, outside of the realms of formal education.
4. They do not need to be told what is; they can google it just fine. They do not want to be told what to do; they know they thrive much better when they lead their own exploration. They do need guidance, mentoring, and nurturing as whole human beings.

2.2 Rethinking our assumptions about the employers and the skills they need

The question:

Does the economy of the near and long term future demand different graduate characteristics than those that the current higher education has been targeting? If so, how? Are there skills we are cultivating that have become irrelevant? Are there new skills for which we are not cultivating?

The Hypothesis: When the scarcest resource becomes abundant, the economy changes (Anderson, 2009). We are no longer in a Knowledge economy. This is a Thinking Economy. We need to focus on the skills needed by the new economy. What are they?

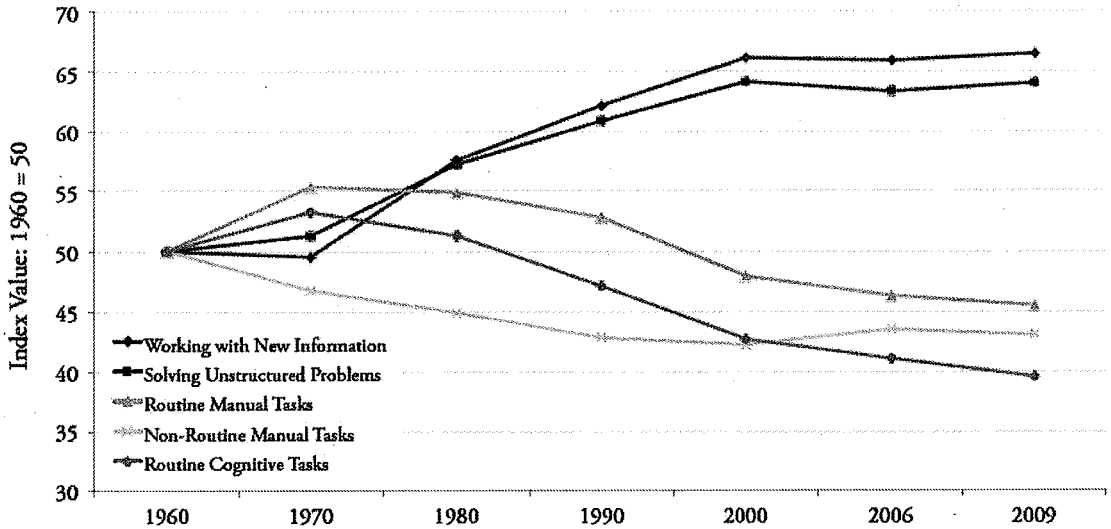
The pervasive influx of Information Technology, smart devices, and social media in work and life has dramatically altered our culture in all of its facets. The Book OPEN by David Price (Price, 2013) illustrates this in vivid details. One of the key changes is that the scarcity of knowledge around which much of academia has been organized, has disappeared. Indeed, knowledge has become a commodity that is abundant, ubiquitous, consumed, and produced by the masses. The industry has been the first to feel the tremors of this dramatic shift and has altered drastically the characteristics of the employees it seeks and hires. The impact of this change is that many of previously high paying jobs have been disappearing, but many other opportunities are also emerging.

When the most scarce resource becomes abundant, the economy changes. We are no longer in a Knowledge economy. This is a Thinking Economy.

In their report *Dancing with Robots* (Murnane, Dancing with Robots: Human Skills for Computerized Work), Harvard (Murnane) and MIT (Levy) researchers argue that “the human labor market will center on three kinds of work: solving unstructured problems, working with new information, and carrying out non-routine manual tasks”. They base their assessments on data some of it is illustrated in the following graph. Maybe the most surprising trend in this graph is the green line for “Routine Cognitive Tasks.” These are tasks that require highly knowledgeable professionals such

as accounting, legal advising, financial planning, and technological and engineering routine jobs. All of these can and will be automated.

Figure 3: Index of Changing Work Tasks in the U.S. Economy 1960-2009²¹



In summary, the current higher education system is designed around the premise that we are serving a knowledge economy in which we are producing “organization men” (Whyte, 2002) who are knowledgeable, proficient, and efficient at working in a predictable cognitively routine way. All indications show that these jobs are disappearing and being automated away (Hamm, 2013) (Murnane, Dancing with Robots: Human skills for computerized work, 2013) (Price, 2013). The new economy that we are calling Thinking Economy values different sets of skills and different mind habits.

Repeated employers’ surveys about what they are looking for in an employee are generally consistent in the set of skills and their relative importance. See for example the 2006 Conference Board report (The Conference Board, 2006). They are a variation of the following:

- 1) Critical thinking and Problem Solving: ability to learn; ability to ask good questions; ability to solve unstructured problems.
- 2) Information Technology Applications: Ability to find, assess credibility, analyze and interpret data using Information Technology tools.
- 3) Teamwork and Collaboration: Ability to empathize, listen, negotiate, learn with and from others. This includes verbal and written communications. Ability to capitalize on diversity and work in global settings.
- 4) Creativity and Innovation: Ability to see opportunities and seize them. Ability to solve an old problem in new ways and bring about something new.

These are also consistent with the seven survival skills identified by Harvard Education Researcher Tony Wagner: 1. Critical thinking and problem solving, 2. Collaboration across networks and leading by influence, 3. Agility and adaptability, 4. Initiative and entrepreneurship, 5. Effective oral and written communication, 6. Accessing and analyzing information, and 7. Curiosity and Imagination.

2.3 Rethinking the education of the 21st Century

The question:

How well is the current educational system meeting the needs of the students and the economy, and what can be done to increase the fit? Based on the findings to the first two questions, what aspects of what we do and how we do it need to be revised and changed?

The Hypothesis: These are different students; this is a new economy; we need more than incremental changes to cater to the millennials and prepare them for the thinking economy. We must question everything: learning outcomes, pedagogy, governance, credentialing, financing, faculty preparation and support.

When the focus is on *knowing* the right answer, imagination, cooperation, and diversity are a problem. When the focus is on thinking, creating, and collaborating, diversity is the solution.

2.3.1 Contents and Pedagogy

| Hypotheses to explore | | |
|--------------------------|--|--|
| category | | Research question |
| Learning Outcomes | <p><u>Skills:</u> This is the focus of current curricula; discipline specific knowledge and know how. Knowledge is still important. Thinking, problem solving, and creativity need domain knowledge. Specific contents may no longer need to be so rigid though.</p> <p><u>Habits of Mind:</u> These are the discipline agnostic skills listed by employers including problem solving, lifelong learning, collaboration, creativity.</p> | <p>Current education focuses on the skills almost exclusively and counts on the habits of mind to be acquired as a by-product. Employers' surveys show that this is wishful thinking.</p> <p>Questions:</p> <ul style="list-style-type: none"> • How to make habits of mind deliberate learning outcomes? • Can we realistically accomplish both? How? • Which successful examples can we draw and learn from? |

| | |
|-----------------|---|
| Pedagogy | <p>Questions: <u>Students' autonomy:</u> Students learn best when driven by their own motivation (Deci & Ryan, 2013), when they follow their own passion, and when they build on their experience of learning through exploration (Brown, 2011). How to shift from a teaching mode of sage on the stage to guide on the side and still ensure that all outcomes are met?</p> <p><u>Focus on answers:</u> When the focus is on <i>knowing</i> the right answer, imagination, cooperation, and diversity are a problem. When the focus is on thinking, creating, and collaborating, diversity is the solution. How to create a classroom that values curiosity, imagination and question asking? How to create a classroom where the focus on <i>knowing enough to ask good questions</i>. How to create a classroom where every answer found allows us to ask better questions (Brown, 2011)? How do we switch from a focus on testing "what do I know" to a focus on "what are the things that I don't know and what questions can I ask about them?" (Brown, 2011)</p> |
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2.3.2 Credentialing and Financial Model

In the current Higher education system, students are billed based on a credit hour system; their studies are sanctioned based on a calculation of credit (sitting in classroom) hours. There is little correlation between what students know and what they have acquired and the number of credit hours.

A better measure of student learning is through demonstrated and documented competency. Such approach presents several advantages:

- It allows for variability and personalized learning. Two students taking the same class do not necessarily learn the same thing and do not necessarily learn at the same speed. Decoupling acquired competencies from number of seat hours benefits the students and gives a better documentation of what they have learned.
- It allows students to take risks and explore based on their interests and passions. This enhances and increases their learning and hones the type of mind habits that the employers say they value.
- It sanctions learning whenever and wherever it happens and better integrates formal and informal learning. Students can learn on their own, from peers, using a MOOC, and they get their learning sanctioned and credentialed by the faculty.

We will experiment with using a badge system, at first in parallel with regular credit/letter grade system.

2.3.3 Governance

Universities remain fairly traditional in their reliance on hierarchical governance structures and in their strict separation of disciplines within the university. As a result collaboration and cooperation between faculty from different disciplines is not supported and often discouraged. We are interested in identifying alternate governance structures more aligned with the philosophy and aims of PPI.

2.3.4 Faculty Preparation and Support

Faculty teaching is one of the few professional activities where its practitioners get no or very little training and get no or very little support and constructive feedback while they practice it. This is true of the teaching professions in general. Tony Wagner makes the same observation about High School teachers and administrators. The Finnish educational system (Sahlberg, 2011) on the other, touted as one of (if not the) best educational systems in the world is distinguished by the amount of initial training and continuous collaboration between teachers and mutual feedback on their lessons and teaching performance. Shifting gears from teaching the way we were taught to adopting completely new approaches will require training and support. We are interested in identifying and testing collaborative approaches by which we can assess and improve performance of the faculty.

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