Marrying the Red Bricks and the Free Bits of Learning[1]

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The Purdue Polytechnic Initiative (PPI) aims at transforming undergraduate education in the College of Technology by adopting and adapting some of the most innovative and forward thinking ideas and approaches in education. The PPI is motivated by the conviction that undergraduate education has become dangerously misaligned with the needs and aspirations of the students and the demands of future economies. The PPI aims to create an educational environment that addresses some of the key shortcomings summarized in (Mili & Bertoline, 2013) guided by a set of values outlined in (Bertoline & Mili, 2013). Some of the criticisms of higher education focus on the high and increasing costs of a College degree and on the perceived diminishing return on investment of such a degree which together are limiting access. Access and openness are key values underlying PPI. In this paper we discuss the issues of access in an age that is increasingly open and outline how PPI's views and approach to supporting openness and guaranteeing access.

1. The Creative Tensions of Higher Education

The Higher Education system has been barraged in recent years by a chorus of criticisms, questions, and challenges. Chief among these are the increasing tuition costs, the uncertainties of the job markets of the future, and the misalignment between the open, communal, and collaborative worlds of wikipedias, social media, and crowdsourcing on the one hand, and the traditional, individual, and competitive worlds of academia on the other hand. We use Peter Senge's terminology (Senge, 2006) and refer to these mismatches as *creative tensions* between current realities of higher education and visions of where *we* would like the Purdue Polytechnic Institute to lead. Creative tensions lead to actions that bring reality closer to the vision we want to realize.

The tensions stem in part from the fact that we have irreversibly shifted from the Encyclopedia era to the Wikipedia era yet higher education institutions have not followed in this shift, or not fast enough. In the Encyclopedia era, knowledge is created, validated and transmitted by the select few who inhabit the "ivory towers" of Academia. This is a closed system whose quality assurance is based on the processes by which the contributors are groomed, credentialed, and selected, and by the rigorous processes of peer and editorial reviews. Encyclopedic knowledge is scarce, concentrated, and changes in a slow and deliberate fashion. By contrast, in the Wikipedia era, knowledge is created, edited, and validated by the crowds. Everyone has a voice and can contribute. This is an open system whose quality assurance is based on its scale: the sheer number of contributors and reviewers. The passions and motivations of the contributors are their only relevant credentials and their number creates a whole new phenomenon that is much bigger than the sum of its part. As pithily coined by physicist Anderson, "More is Different". Wikipedia knowledge is ubiquitous, distributed, and fast changing. Access to Wikipedia knowledge is fast and free.

[1] Last updated on 11/17/13 Please visit https://polytechhub.org/resources for the latest version.

The tensions also stem from the diversification of the locus of competence and expertise. Academia has always cultivated and certified individual competence. Individuals follow curricula, take tests and exams in isolation, and receive individual diplomas certifying their competence. They are the locus of knowledge and experience. Many civilizations and cultures assign knowledge and expertise to communities as well as to individuals. Social networking and online communities have triggered the resurgence of expertise within communities. This has been observed most commonly in medical and health-related domains. David Price (Price, 2013) gives a personal testimony where an online community was key to helping him recover his health and providing him with the knowledge and expertise that his doctors did not have. His example is not an isolated case. This is another illustration of the power of crowds of private citizens driven by a common passion, motivation, and generosity with their cognitive surplus (Shirky, 2010).

Another source of tension is the conflict between the rising expectation of post K-12 education for all and the rising cost of such education that limits access. What used to be seen as a privilege reserved for the few who are gifted or who can afford it, has become a necessity and expectation. The National Center for Public Policy and Higher Education, established in 1998, has been tracking Americans' attitudes towards Higher Education. In their 2008 survey, they found that the proportion of individuals who believe higher education to be "absolutely necessary" for success increased from 31% in 2000 to 55% in 2009[2]. Data from the 2011 U.S. Census Bureau is consistent with this perception. The average earning of a person with a Bachelor Degree is double that of a person with a High School diploma. Americans see a college degree as a necessary ingredient to securing a middle class lifestyle. At the same time, the percentage of Americans who see access to Higher Education as an issue has dramatically increased in the recent past. More than two thirds of Americans (67 percent) now saying that access is a problem, the highest documented level since the National Center for Public Policy and Higher Education has started tracking these trends. This conflict between the perceived necessity of a college degree and (perceived) elusiveness is felt even more keenly by minority members of the public.

Another significant source of tension is the co-existence of two economies: the atoms economy, and the bits economy (Anderson, 2009). The atoms economy is the economy of physical artifacts. It is generally inflationary; most things get more expensive over time. The bits economy is the economy of digital artifacts. It is deflationary; the prices of processing, storage and communication bandwidth are dropping faster than Moore's law. Anything captured digitally will inevitably see its price drop until it becomes too cheap to matter (if not "too cheap to meter"[3]). In other words, it becomes so abundant that it makes more economic and creative sense to waste it than to meter it and optimize it. Repeatedly we have seen how a scarce resource that becomes abundant changes the equation and unleashes creativity and novelty. This has been witnessed for example when a team at Xerox's Palo Alto Research Center, under the leadership of Alan Kay, decided to shift from using processing as the scarce resource to save and optimize to considering it as an abundant resource to "waste" on playful things such as drawing icons, steering pointers with a mouse, and creating animations. This 1970's experiment led to the birth of Graphical User Interfaces and is at the core of the penetration of computers as a commodity (Anderson, 2009). The bit and free economy is thus not only a quantitative adjustment. By making abundant a previously scarce resource, it introduces a qualitative change to the creative processes of the associated disciplines. Given its disruptive nature, several industries have resisted, fought, and lost the war against the new bit economy of free. The music industry has now learned how to capitalize on

[2] http://www.highereducation.org/reports/squeeze_play_09/report.shtml

[3] "In 1954, at the dawn of nuclear power, Lewis Strauss, the head of the Atomic Energy Commission, stood before a group of science writers in New York City and foretold great things to come ... And, most famously, he predicted, "It is not too much to expect that our children will enjoy in their homes electrical energy too cheap to meter."" (Anderson, 2009)

the free circulation of music to grow the number and attendance at live concerts among other things. The software industry has gone through the 5 stages of grief before accepting the fact that open source software is here to stay, and grow. They have realized that there is something to gain from embracing it and learning from it. The growth of MOOCs and the various attempts at incorporating them in universities' portfolios are an unmistakable sign that higher education is not immune to the challenges of the bit economy.

2. Learning wants to be free

> "He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me."
> Thomas Jefferson

Internet activist Stewart Brand has captured the tension between access and copyright in his iconic statement: "Information wants to be free. Information wants to be expensive." He elaborates on the paradox: "It leads to endless wrenching debate about price, copyright, 'intellectual property,' and the moral rightness of casual distribution." (Tapscott & Williams, 2013). PPI's position relative to this concept is captured by the values of openness, access, autonomy, and community, which we restate here.

<u>We value openness.</u>
We value complete openness in everything we do. We value sharing and collaboration through open access to all data, knowledge, and artifacts. We value the creative powers of the communities as much as those of the individuals. We have entered an era of collective and collaborative learning, production, and consumption of knowledge. We embrace openness that underlies this communal way of working. This openness is practiced through making all of our resources available but also by recognizing other resources in their diversity, by assessing them with openness and fairness, and by incorporating them in what we do. Openness is practiced at all levels in PPI. We believe that openness breeds trust and collaboration.

<u>We value access.</u>
We value access to education to all students through the nurturing and support of all talents and sensibilities. We value access to education to all students in their diversity of preparation, experience and backgrounds. Education beyond what is covered in the K-12 curriculum has become a necessity for the well-being of all citizens. Education is a right to all students, whether it is delivered through formal institutions or not. We believe it is important to integrate formal and informal learnings.

<u>We value students' autonomy with their learning.</u>
Learning rather than teaching is the core of education. We believe that learning is a personal act of discovery that is best fueled by strong motivations and commitments from the students. Faculty play a key role in supporting rather than driving students' learning. We value all means by which the students can control what they learn, when they learn it, and how they learn it.

<u>Learning has irrevocably escaped the walls and gates of the schoolyard</u>.
Notwithstanding the fact that it never was fully trapped inside these walls and gates, the learning that happens within the k-16 years and in formal school and college settings has always worn the mantel of exclusive legitimacy. The quality, quantity, and recognition of the learning taking place outside of these confines are growing exponentially. MOOCs are one of the manifestations of the escape from the

formal setting which forced the separation between competency (acquiring the material and passing the course) and credentialing (have the means to prove it to others). Many other forms of learning preceded MOOCs and many more are emerging thanks to a highly connected and open world. We recognize this fact and account for it in what we can and should provide to our students.

3. Marrying the Red Bricks with the Free Bits

The question we address here is how to marry Purdue's traditional red bricks tuition-based education with other forms of learning including the free bits of MOOCs within the scope of the Purdue Polytechnic Institute. Although the bits economy refers specifically to digital artifacts, our interest is in the combination of the formal, traditionally tuition-based learning with all other forms of learning, including MOOCs. We see the integration of other forms of learning as both a value-based and economic-based decision. We first propose ways in which this integration can take place then discuss how such approach is in line with the PPI initiative.

The PPI education leaves the students at the helm of their learning as much as they are ready for. One of the ways in which the students are in charge is the content and speed of the learning. In particular, we decouple the amount of learning from the number of credit hours. The faculty offer their presence and support to the students; the students guide the contents and speed of learning. Credit hours quantify the faculty's presence; an orthogonal mechanism will be used to credential the learning such as certificates, badges, or any other units. Within the same credit hour containers, students can potentially acquire different types and a different number of credentials, some of them from the PPI faculty, others may be from other Purdue or non-Purdue sources including MOOCs. We illustrate this mechanism using a sample scenario.

Project Great Lakes Invasive Species

Three students, Amy, Bob, and Carla enroll in a 3 credit project held over two consecutive semesters. The theme of the project is to look at the problem of invasive species in the Great Lakes. Students are invited to form teams and select a specific problem or research question they want to address. The class has several teams; each team selected one area to focus on. Amy, Bob, and Carla's team focused on the origin of invasion and ways to prevent it. They focused on one sources of invasion: Ballast water charged into or discharged from ships to balance the ship's weight as it loads or unloads its cargo. With guidance from their faculty mentor, her team learned about ballast water in ships, why it is needed and how it works. They researched the history of the use of ballast water and looked at alternatives. They also considered mechanisms by which they can control the growth and survival of the organisms carried with ballast water. At the end of the project, all three have gained knowledge in fluid dynamics, structural design, and marine biology. They each received badges in each of these three areas. In addition, Amy took a MOOC on ship design offered by a university in Norway; Bob did a project on the use of genetics to prevent the survival of organisms outside of their native habitat under the supervision of a faculty member in the department of biology. Carla took a 6-week course on CAD/CAM from Ivy Tech and used the learned skills to create many alternative ship designs that would reduce the volume of ballast water needed. Another team in the same class focused on the economic impact of the invasive species by collecting data, using simulation tools to predict the growth and spread of the invasive species based on their biological properties and by identifying the

impact on various sectors of the economy. A third team focused on the history of invasive species and their positive and negative impacts throughout history. They selected a set of fauna and flora species in Indiana and traced their origins and the way by which they became native and changed the landscape.

The scenario above illustrates several elements of the proposed approach in PPI:
The guided but seamless integration of the Red Bricks with the Free Bits: With the students at the helm of their learning, all resources of learning are accepted and valued with an open mind. With respect to MOOC's, the reservation often expressed about them is the recognition of credentials gained through MOOC's. By integrating within PPI, MOOCs or other sources are the place where the learning takes place, the guidance and the certification are the responsibility of the faculty. A student may decide to take only the first 6 weeks or only a specific topic from a MOOC class. Overall, the students learn from a continuum of sources but the credentials are certified by faculty from Purdue. In the scenario above, all the students are taking the same number of credits (3 credits over two semesters), yet they construct a portfolio with a personalized learning and a different number of badges. Some students choose to go faster and graduate earlier, and at a reduced cost (e.g. in three years); others may decide to just build a richer portfolio, i.e. take the same time but accumulate a thicker portfolio. The mechanisms by which certification and assignment of badges will take place is still to be decided.

Increasing Access: This approach is in line with increasing access. Students receive learning from the atoms economy thereby getting the caring support and the expert and personalized attention from their faculty mentors. They combine this with learning in the bits economy or other venues where they are more fully in control, but benefit from the free resources and other learning communities available to them. More students will be able to get access –financially—than if it were 100% atom-delivered. The balance between the number of atoms-based badges and bits-based badges is to be decided. A priori, we will use the Yahoo's approach of "you can go as far as you want but not as fast as you want" (Anderson, 2009). In other words, we will not put a limit on the number of bits-based (or non-Purdue) badges that a student can get but may limit the number of such badges they can get per semester or the overall percentage of their total number of badges.

Increasing Openness: One of the consequences of the bit-economy is that it runs against the Not Invented Here syndrome and benefits all by increasing the sharing and exchange of ideas. Providing faculty full exposure of the learning that students get from a variety of sources can only increase their openness, accelerate their learning, and improve the services they in turn provide to the students. This approach will break silos and build bridge between all providers of learning.

Increasing Diversity: Traditionally academia has strived to accommodate the needs of students and families. The very structure of the academic year was designed to accommodate the farming calendar. As the demographics and the needs have changed, accommodation has not always caught up rapidly enough. For example, many structural and administrative barriers make higher education less accessible to several under-represented groups. We hope that the hybrid atoms-based and bits-based will introduce more flexibility and thus be more welcoming to a broader range of the population.

4. In closing

The approach outlined here is the economic facet of PPI. PPI is an initiative and an opportunity to question assumptions and experiment with new ideas. The issues of access, openness, and diversity are

cornerstone in our approach. They cannot be fully realized without considering the full spectrum of learning modes and without considering the economic barriers. Furthermore, the growth of the bits economy is inevitable. PPI is in a unique position to be an early adopter.

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